

WEST BRANCH OF THE
GRAND CALUMET RIVER BASIN
EAST CHICAGO, INDIANA

FINAL
ENVIRONMENTAL HEALTH AND SAFETY PLAN

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Revision 0

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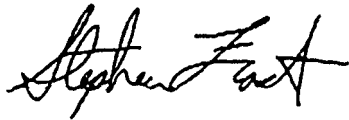
APPROVALS

By their signature, the undersigned certify that this Environmental Health and Safety (EHS) Plan will be utilized for the protection of the health and safety of personnel during fieldwork conducted on the West Branch Grand Calumet River in East Chicago, Indiana.



Project Manager
Mark Herrenkohl

October 10, 2002
Date



Project Environmental and Safety Manager
Steve Frost

October 10, 2002
Date

Foster Wheeler Environmental Corporation, Foster Wheeler subcontractors, and the U.S. Fish and Wildlife do not guarantee the health or safety of any person entering this site. Due to the nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other site without prior research and evaluation by trained health and safety specialists.

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ACRONYMS AND ABBREVIATIONS

$\mu\text{g}/\text{m}^3$	micrograms per meter cubed
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
ATV	all-terrain vehicle
CGI	combustible gas/O ₂ indicator
CRZ	contamination reduction zone
dB	decibel
EBGCR	east branch of Grand Calumet River
EHS	Environmental Health and Safety
EPA	U.S. Environmental Policy Act
EZ	exclusion zone
FOL	Field Operations Leader
Foster Wheeler Environmental	Foster Wheeler Environmental Corporation
GCR	Grand Calumet River
GCRRF	Grand Calumet River Restoration Fund
H ₂ S	hydrogen sulfide
IDEM	
IDNR	
mg/m^3	milligrams per meters cubed
MSDS	Material Safety Data Sheets
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
PEL	permissible exposure limit
PESM	Project Environmental and Safety Manager
PFD	personal flotation device
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
RAP	Remedial Action Plan
SHSO	Site Health and Safety Officer
SOW	Scope of Work

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SZ	support zone
TLV	threshold limit value
TWA	time-weighted average
USFWS	U.S. Fish and Wildlife Service
WBGCR	West Branch of the Grand Calumet River

1. INTRODUCTION

This plan has been prepared in conformance with Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) Health and Safety Plan guidelines, applicable Occupational Safety and Health Administration (OSHA) regulations, and project requirements. It addresses those activities associated with work to be performed on the West Branch of the Grand Calumet River (WBGCR), located in East Chicago, Indiana. The Field Operations Leader (FOL) and the Site Health and Safety Officer (SHSO) will implement this plan during site work. Compliance with this Environmental, Health, and Safety (EHS) Plan is required of all persons and third parties that perform fieldwork for this project. Assistance in implementing this EHS Plan can be obtained from the Foster Wheeler Environmental Corporation Project Environmental and Safety Manager (PESM). The content of this EHS Plan may change or undergo revision based upon additional information made available to health and safety personnel, monitoring results, or changes in the technical scope of the work. Any changes proposed must be reviewed by the FOL/SHSO and are subject to approval of the PESH. The Field Change Request Form provided in Appendix A may be used to initiate such changes. Refusal or failure to comply with the EHS Plan or violation of any safety procedures by field personnel and/or subcontractors may result in immediate removal from the site following consultation with the PESH and the Project Manager (PM).

This plan has been prepared by Foster Wheeler Environmental in accordance with the requirements of the Scope of Work (SOW) for Task Order 02-Y037 of Contract 1448-98695-98-C008, dated August 5, 2002. The EHS plan was prepared for the U.S. Fish and Wildlife Service (USFWS) Environmental and Facility Compliance Office at the request and direction of the USFWS – Bloomington Field Office as a project planning document for the implementation of the chemical, physical, and toxicological characterization of the West Branch of the Grand Calumet River, Indiana (GCR). The USFWS is acting as the contracting agency on behalf of the Grand Calumet River Restoration Fund (GCRRF) Council, which is composed of USFWS, Indiana Department of Environmental Management, U.S. Environmental Protection Agency (EPA), and Indiana Department of Natural Resources.

1.1 SCOPE OF WORK

The primary work activities associated with the project include the following:

- Mobilization/demobilization
- Bathymetric survey of river bottom
- Topographic survey of the river banks
- Sediment coring and sample preparation

Site work on the WBGCR will involve conducting a bathymetric survey of the river bottom and a topographic survey of the riverbanks. These surveys will cover approximately two and one-half miles of the west branch from Indianapolis Boulevard Bridge to the Indiana / Illinois state line. The bathymetric surveys will be conducted from a small motor boat or “swamp buggy” using a two-person crew. A three-person survey team will be subcontracted to collect topographic measurements up to 200 feet inland along both sides of the river.

Sediment core samples will also be collected from three-station transects across the river, separated approximately 1,000 feet apart within each reach. Cores will be advanced using a vibracore mounted on a small, pontoon boat / coring platform. Approximately two sediment samples from each core will be submitted to an analytical laboratory for chemical and physical testing. The vibracore drilling crew will retrieve the sediment samples in 12- to 15-foot-long CAB core tubes which will be capped at the drill site and transported to a field processing station located on-shore. A large moving van trailer, equipped with tables and chairs, will be used to examine and prepare the core samples for shipment. This mobile processing facility will be re-located, as necessary, to keep pace with the drilling work as it moves down river.

1.2 APPLICATION

This EHS Plan applies to all personnel involved in the above tasks who wish to gain access to active work areas. These include, but are not limited to, the following:

- Client representatives
- Federal, state, or local representatives
- Foster Wheeler Environmental employees and subcontractors

1.3 MAJOR RISKS

Major risks may include the following:

- Work on and around water
- Exposure to site contaminants
- Biological hazards
- Slips, trips, and falls

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

This section specifies the Foster Wheeler Environmental Project Organization and responsibilities.

2.1 PROJECT MANAGER

Mr. Mark Herrenkohl is the PM for this project. His responsibilities include the following:

- Ensures implementation of this program through coordination with the responsible PESM
- Participates in major incident investigations
- Ensures the EHS Plan has all of the required approvals before any site work is conducted
- Ensures that the PESM or SHSO is informed of project changes which require modifications of the site safety plan
- Has overall project responsibility for project health and safety
- Ensures adequate personnel and equipment are available to complete the project safely.

2.2 FIELD OPERATIONS LEADER

Mr. Bob Feldpausch is the FOL for this project. His responsibilities include the following:

- Ensures the EHS Plan is implemented
- Ensures field work is scheduled with adequate personnel and equipment resources to complete the job safely
- Enforces site health and safety rules
- Investigates incidents
- Ensures the PESM is informed of project changes that require modifications to the EHS Plan
- Ensures proper personal protective equipment is utilized
- Ensures project personnel have appropriate training and experience to do the work

- Assigns work and monitors performance
- Communicates all pertinent health and safety and regulatory compliance issues to the client.

2.3 SITE HEALTH AND SAFETY OFFICER

Ms. Jennifer Hawkins is the SHSO for this project. Her responsibilities include the following:

- Monitors compliance with the EHS Plan
- Evaluates the adequacy of personnel and equipment resources to complete the job safely
- Helps enforce site health and safety rules
- Investigates incidents
- Ensures that the PESM is informed of project changes that require modifications to the EHS Plan
- Conducts site safety briefings
- Ensures proper personal protective equipment is utilized
- Notifies PESM of all accidents/incidents
- Reports to PESM to provide summaries of field operations and progress
- Acts as Emergency Coordinator.

2.4 PROJECT ENVIRONMENTAL AND SAFETY MANAGER

Mr. Steve Frost is the PESM for this project. His responsibilities include the following:

- Provides for the development and approval of the EHS Plan
- Serves as the primary contact to review health and safety matters that may arise
- Approves revised or new safety protocols for field operations
- Approves individuals who are assigned site safety responsibilities
- Coordinates revisions of this EHS Plan with field personnel

- Coordinates upgrading or downgrading of personal protective equipment with the FOL/SHSO
- Assists in the investigation of high loss incidents, including near misses.

2.5 SITE PERSONNEL

The following responsibilities pertain to all site personnel:

- Report any unsafe or potentially hazardous conditions to the FOL/SHSO
- Maintain knowledge of the information, instructions, and emergency response actions contained in the EHS Plan
- Comply with rules, regulations, and procedures as set forth in this EHS Plan and any revisions
- Prevent admittance to work sites by unauthorized personnel
- Prior to use, daily inspect all tools and equipment, including personal protective equipment (PPE).

3. SITE LOCATION AND HISTORY

3.1 PROJECT HISTORY AND SUMMARY

The Great Lakes Water Quality Agreement of 1978 identified the GCR and Indiana Harbor Canal as one of 43 areas of concern having one or more specific impairments to beneficial uses of Great Lakes waters. The Agreement directed that a Remedial Action Plan (RAP) be developed and implemented at each area of concern in order to restore the beneficial uses. IDEM submitted a Stage 1 RAP to the International Joint Commission in 1991 and a Stage 2 RAP in 1997.

Following settlement with Industrial Users of the Hammond Sanitary District in February 1997, a Trust Agreement for GCRRF was established and by Memorandum of Understanding among EPA, USFWS, IDNR and IDEM. At this time, the GCRRF Council was established. Payments to the GCRRF by settling parties was to address the effects of sediment contamination in the WBGCR, specifically for the purpose of addressing and correcting environmental contamination in the area of concern, including particularly the cleanup of contaminated sediment in the GCR and the remediation and restoration of natural resource damages within the area of concern.

3.1.1 Site History

The GCR comprises two east-west oriented branches that meet at the southern end of the Indiana Harbor Ship Canal. The east branch of the Grand Calumet River (EBGCR) originates at the Grand Calumet Lagoons, just east of the United States Steel Gary Works Facility. The EBGCR flows west from this point for approximately 10 miles to its confluence with the Canal. The WBGCR usually flows both east and west, with a hydraulic divide typically present in the vicinity of the Hammond Sanitary District outfall just east of Columbia Drive. Historically, amount and direction of water flow through the river was determined by Lake Michigan water levels. During periods of high lake levels, flow may be to the west throughout the WBGCR. Drops in the level of Lake Michigan since 1997 has resulted in reduced water level in the river.

The natural watershed of the GCR lies within the Calumet lacustrine plain, which extends from the modern Lake Michigan shore of the Valparaiso terminal moraine. The Lake Michigan lobe of the Laurentian ice sheet began to retreat, after the Wisconsin glaciation, and the Valparaiso terminal moraine marks its furthest southern advance before receding.

Prior to about 1850, the GCR flowed east from a point near the GCR to the area now encompassed by Marquette Park in Miller, Indiana, where the river emptied into Lake Michigan. As the western end of the river was developed for navigation at the confluence with the Little Calumet River, the mouth of the GCR at Marquette Park became permanently closed by sand dunes. Construction of the Indiana Harbor Canal began in 1903.

3.1.2 Environmental Setting

Approximately 2-1/2 miles of the WBGCR, located between Indianapolis Boulevard and the Indiana/Illinois State line, will be evaluated in this study. Based on a preliminary analysis of potential remedial technologies, the physical site conditions, and waterway setting, Foster Wheeler Environmental has proposed a division of the WBGCR into the following project reaches:

1. from the Indianapolis Boulevard Bridge to the Interstate 90 Bridge,
2. from the Interstate 90 Bridge to the Columbia Avenue Bridge,
3. from the Columbia Avenue Bridge to the Calumet Avenue Bridge,
4. from the Calumet Avenue Bridge to the Sohl Road Bridge,
5. from the Sohl Road Bridge to the Hohman Avenue Bridge,
6. from the Hohman Avenue Bridge to the railroad bridge, and
7. from the railroad bridge to the Indiana/Illinois state line.

Phase 2 work will be referenced within these proposed divisions of the WBGCR.

4. POTENTIAL HAZARDS OF THE SITE

4.1 GENERAL

This section presents an assessment of the chemical, physical, and biological hazards that may be encountered during the tasks specified under Section 1.1.

4.2 CHEMICAL HAZARDS

A review of chemical sampling data collected within the WBGCR has identified numerous semivolatile (i.e., polynuclear aromatic hydrocarbons [PAHs], polychlorinated biphenyls [PCBs], pesticides, phthalates, dioxins), volatile (i.e., chlorinated aromatic hydrocarbons, benzene), and heavy metal (i.e., arsenic, lead, cadmium) contaminants in the sediments that underlie the river (see complete list of contaminants in Appendix I). Almost all of these compounds are present at relative low concentrations – a few hundred parts per million (ppm) – and are undoubtedly either intermixed with or adsorbed onto the sediment particles. It is likely that small pockets of methane and/or hydrogen sulfide gas infiltrate the sediments as a result of anaerobic digestion occurring over time within the organic rich, sulfide-laden sediments. It is possible that these gases could be released into the workplace air during processing of the sediment samples.

Despite the multitude of compounds identified at the site, none of the contaminants are present at levels that could be considered significant from an occupational exposure standpoint, at least with regard to Federal OSHA's Permissible Exposure Limits where inhalation of the offending chemical agent is the exposure route of concern. This evaluation is based on the fact that most of the aforementioned site contaminants are solids that are intermixed with the sediments at relatively low concentrations or are semi-volatile liquids which are adsorbed onto the surface of the sediment particles. As such, inhalation exposures to these materials would require the airborne suspension of particulate from the contaminated sediments. But because all samples will be saturated with water, dust generation is unlikely. If some dust is produced, the concentration in the air could not realistically approach levels in excess of the aforementioned permissible exposure limits. As indicated above, though, hydrogen sulfide gas, methane, and possibly small amounts of volatile organic solvents (i.e., benzene) could be released into the air when the core samples are processed for shipping.

A more significant exposure concern than dust inhalation on this project is direct skin contact with the site contaminants. Several of the contaminants are substances which, if exposed to the skin can, to some degree, be cutaneously absorbed into the body (see American Council of Government Industrial Hygiene Threshold Limit Values with “skin” notations) or cause other adverse skin effects. These materials include the PAHs (chrysene, benzo(a)pyrene, naphthalene, anthracene, phenanthrene, and pyrene), chromium, arsenic, nickel, mercury, PCBs, heptachlor, 4-methylphenol, and, most particularly, 2,3,7,8 dibenzo-p-dioxin. Fortunately, the actual concentrations of these materials in the contaminated sediments are relatively low (ppm range) and, as such, are not highly hazardous from a skin absorption standpoint. Nonetheless, chemical protective clothing will be worn whenever contaminated sediments are handled. Decontamination measures will also be instituted to further reduce contaminant contact and to minimize the spread of contamination in the work area.

In addition to the dermal contact controls mentioned above, organic vapor and hydrogen sulfide (H_2S) measurements will be taken at the jobsite during examination and processing of the vibracore samples to ensure volatile solvent vapors and H_2S gas levels are within safe limits. A direct reading vapor monitor, such as an Hnu photoionizer detector (PD) or Organic Vapor Analyzer, and a combustible gas / O_2 / H_2S meter will be used to collect these measurements. The combustible gas indicator will also be used to indirectly detect methane gas as methane, although non-toxic, can become combustible at high concentrations. If high organic vapor levels are noted in the work area, a Drager Tube sampler will be used to test for benzene since the permissible exposure limit for this volatile compound is exceptionally low (1 ppm).

A listing of current occupational exposure limits, primary toxicological effects, and relevant physical properties for each of the skin absorbable contaminants is presented in Table 4-1. It is important to note when reviewing this table that the physical and toxicological data contained therein are derived from studies on concentrated (pure) forms of the contaminants and do not accurately represent the trace quantities or negligible exposure conditions which will be encountered by site personnel working on the project. When evaluating inhalation exposures, the most stringent of the two occupational exposure limits listed—permissible exposure limit (PELs) and threshold limit value (TLVs)—will be referenced as a point of comparison.

Chemical data sheets can be found in Appendix B.

Table 4-1. Chemical Data

CHEMICAL	ACGIH TLV	OSHA PEL	ROUTES OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Arsenic	10 µg/m ³	10 µg/m ³	Inhalation Ingestion Skin contact	Skin and eye irritation, respiratory tract irritation, lung and skin cancer.	Kidneys, liver, skin, lungs, bone marrow, and lymph.	Sp.G.=3.74 BP= 869F MP=599F Reactivity: acids, bases, oxidizers, iron solutions, and zinc.
Nickel	1.5 mg/m ³	1.0 mg/m ³	Inhalation Ingestion Skin contact	Respiratory tract irritation, allergic contact dermatitis, conjunctivitis, asthma, lung and nasal cancer.	Skin, lungs, and sinuses,	Sp.G.=4.84 Reactivity: H ₂ O ₂
Mercury	0.025 mg/m ³	0.1 mg/m ³	Inhalation Ingestion Skin contact	Respiratory tract irritation, allergic contact dermatitis, asthma, skin and eye irritation, bronchitis, dyspnea, GI tract irritation, tremor, and weakness.	Central nervous system, kidneys, skin, lungs, and eyes.	Sp.G.=13.6 BP= 674 F Reactivity: Acetylene, ammonia, azides, calcium, sodium carbide, and copper
Heptachlor	0.05 mg/m ³	0.5 mg/m ³	Inhalation Ingestion Skin contact	Tremor, convulsion, liver damage, potential human carcinogen.	Central nervous system, and liver.	Sp.G.=1.66 BP=293 F VP=0.0003 MP=203 F
PAHs	0.2 mg/m ³ as coal tar pitch.	0.2 mg/m ³ as coal tar pitch volat.	Inhalation Ingestion Skin contact	Skin, eye, and respiratory tract irritation, nervous system effects, skin cancer, teratogenesis.	Skin, eyes, respiratory tract, and nervous system.	Pyrene example: Sp.G.=1.27 BP=759F MP=313F Reactivity: acids and oxidizers.
PCBs	0.5 mg/m ³	0.5 mg/m ³	Inhalation Ingestion Skin contact	Eye irritation, liver damage, chloracne, reproductive effects, potential human carcinogen.	Skin, eyes, liver, and reproductive system.	Sp.G.=1.38 BP=689 – 734 F VP=0.00006 Reactivity: Oxidizers.
Dioxin	Max. * manufacturing spec. of 0.1 ppm	Max.* manufacturing spec. of 0.1 ppm	Inhalation Ingestion Skin contact	Chloracne, liver disorders, teratogenicity, carcinogenicity, immunotoxicity.	Skin, liver, respiratory tract, urinary tract, pancreas, nervous system.	No data
Chromium	0.5 mg/m ³	0.5 mg/m ³	Inhalation Ingestion Skin contact	Respiratory tract irritation, allergic contact dermatitis, asthma, skin and eye irritation, lung sensitization.	Liver, kidneys, skin, lungs, eyes	Sp.G.= 5.10 BP= 7232F MP=4415F Reactivity: Lithium, glycerol
4-Methyl phenol	5 ppm	5 ppm	Inhalation Ingestion Skin contact	Respiratory tract irritation, digestive disturbance, skin and eye irritation.	Lung, pancreas, liver, kidney, circulatory system.	LEL= 1.1% MP= 95F F.Pt= 187F VP= 1 mmHg Sp.G= 1.01 BP= 394F Reactivity: Acids bases, oxidizers
LEL = Lower Explosive Limit F.Pt. = Flash Point VP = Vapor Pressure BP = Boiling Pt UEL = Upper Explosive Limit React. = Reactivity Sp.G. = Specific Gravity MP = Melting Pt. mg/m ³ = milligrams per meters cubed µg/m ³ = micrograms per meters cubed ppm = parts per million * There are no established PELs or TLVs for dioxin. However, regulatory agencies throughout the world enforced in 1971 a maximum manufacturing specification (i.e., amount of dioxin contamination in commercial products) of 0.1 ppm dioxin to protect the general public and commercial applicators.						

4.3 PHYSICAL HAZARDS

A variety of physical hazards may be present during site activities. The most common hazards are struck by/or against hazards during sampling operations. These may include slips, trips, and falls, and temperature extremes. Other physical hazards are due to the use of hand and power tools, and material handling. These hazards are not unique and are generally familiar to hazardous waste workers. Additional specific safety requirements working on or near water will be covered during safety briefings at the project site.

4.3.1 Noise

Federal OSHA's 85-decibel (dB) noise exposure limit could be exceeded for those project personnel working on the survey boats, operating the vibracore drilling equipment, working with power tools, etc. To control this exposure hazard, all personnel working near excessively noisy equipment will be required to wear hearing protection. If necessary, sound level measurements will be collected in the work area, as needed, to evaluate this hazard.

4.3.2 Temperature Extremes

Because all planned work activities will be conducted outside where temperature conditions are unpredictable, there is a risk that site workers could develop heat or cold stress. The likelihood of this occurring is dependent on environmental conditions, the level of work activity, and the personal control measures that are used to manage heat loads (work/rest cycles, use of clothing and/or cooling devices, hydration, etc.). Appropriate control measures will be taken to manage these thermal stress concerns. The SHSO, for example, will monitor ambient temperatures in the work area, track thermal work loads, and determine the need for personal protective and administrative controls. In addition, all site workers will be instructed in the recognition and control of thermal stress symptoms and in the treatment procedures listed in Appendix F.

4.3.3 All-Terrain Vehicles

All-Terrain Vehicles (ATVs) may be utilized to move sampling equipment to various locations at the site. ATVs are driven differently than on-road vehicles. Prior to operating an ATV, each site worker will be briefed in the safe operation of the vehicle, and will perform a driving test. The training and results of the completion of the driving test will be documented by the SHSO.

4.3.4 Slips, Trips, and Falls

Working in and around the site will pose slip, trip, and fall hazards due to uneven wet terrain, slippery surfaces, or from surfaces that are muddy. Potential adverse health effects include falling to the ground and becoming injured or twisting an ankle. These hazards will be controlled by keeping the work area free of debris and other litter. Site workers will wear high traction, steel-toed safety boots and pay careful attention to surface conditions to prevent trip and fall injuries. The work area will be inspected before the start of work each day to identify any hazards that could cause injury. The results of these inspections will be communicated to site personnel during the daily tailgate safety meetings.

4.3.5 Fire

A gasoline powered generator and/or air compressor will be used at the site to power the Vibracore sampler and various other power tools. There is a risk of fire during refueling of this generator, particularly if fuel is spilled in the process. To prevent ignition of this fuel, the generator will be staged and operated outside, away from all ignition sources. Smoking will be prohibited within 100 feet of the generator and fuel storage area. The gasoline will be stored in a safety can and will be bonded to the generator during transfer of fuel. Fuel will not be dispensed from the bed of plastic lined pickup trucks. The generator will be grounded to a conducting rod driven into the ground if such grounding is recommended by the manufacturer. A portable dry chemical fire extinguisher and sorbent pads will be staged at the jobsite in the event of fuel spillage or fire.

4.3.6 Manual Lifting

Collecting boring samples, handling coring equipment, and unloading ATVs (i.e., marsh buggy) will all involve heavy lifting. Such activities carry the risk of back and muscle strain. To control this hazard, workers will be instructed to use proper lifting techniques when moving heavy loads, particularly when unloading ATVs, deploying boats, stowing gear, and handling coring equipment. These techniques will include using mechanical lifting devices whenever feasible to move equipment or supplies. When lifting exceptionally heavy loads (but not more than 50 lbs.) individually, workers will maintain ergonomically safe lifting postures and have others help them if mechanical lifting devices cannot be used.

4.3.7 Boat Operations

Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering and drifting into hazardous areas, and encountering severe weather, to name a few. The risk of a boating accident can be reduced by ensuring the boat operators are experienced, and when applicable, licensed; operating the vessel in compliance with Coast Guard rules and regulations; maintaining the vessel in good mechanical order; avoiding bad weather and dangerous seas; and ensuring emergency equipment is available on-board (i.e., life vests, life rings, life boats, fire extinguishers, communication equipment etc.)

To address these concerns, all work conducted from small vessels (bathymetric surveys, sample core collection) will comply with Foster Wheeler Environmental's Boating Safety Procedure, EHS 6-6, and applicable Coast Guard regulations. Small boats will be operated by experienced crewmembers and all equipment will be inspected prior to use to ensure that it is in proper work order. This inspection will be conducted by the SHSO for each vessel used on a daily basis. Ultimately, though, the boat operator will be responsible for the safety of all personnel on the boat and for the integrity of the vessel and its safety equipment.

Prior to the start of field activities, the boat operator will give a detailed health and safety briefing on the location and use of all vessel safety equipment and the procedures for addressing an on-board emergency (i.e., fire, mechanical failure, man overboard situation, etc.) The maximum number of passengers and weight that can safely be transported shall be posted. The number of passengers shall not exceed the number of personal floatation devices (PFDs). Boat operators and passengers will be required to wear a Type II or equivalent PFD. All personnel working on the boat after dark will be required to wear PFDs with flashing beacons.

Small boats operated by Foster Wheeler Environmental personnel will have at least one sound signaling device and a radio to communicate with support services on-shore. Boating operations will be suspended during severe weather or rough seas.

4.3.8 Hand and Power Tools

Several different portable power tools including Vibracore sampler, skill saws, and drills, may be used during the project. Power tools can cause injury if their wiring is defective, guards are missing, kill switches are broken, metal fatigue or cracks are present in

reciprocating cutting and drilling appliances, if the tools are used in a manner other than what they were designed for.

To control these hazards, all power tools will be inspected before and after each use. Any defects noted during these inspections will be immediately repaired or the tool will be taken out of service. Under no circumstances will power tools be used in an inappropriate (non-specified) manner. Tool operators will be trained in the use of each type of tool they will be required to use. All electrically powered tools, as well as all electrical equipment used on site, will be connected to power sources equipped with ground fault circuit interruptors. In addition, extension cords used with the power tools will be equipped with waterproof couplings to prevent electrocution in the wet conditions at the marsh. Portable tools will be stored in a clean, secure area after each day's use.

4.3.9 Sediment Coring Equipment

In order to collect sediment samples, a vibracore and support frame will be used. Working with and near this equipment poses many potential hazards that can result in serious physical harm. These harms can include being struck by or against the equipment or pinched or caught by the equipment. These hazards will be avoided by ensuring that all rotating or reciprocation parts of the vibracore are guarded or shielded and operators keep their hands away from any coring or cutting surfaces.

4.4 BIOLOGICAL HAZARDS

During the course of the project, there is potential for workers to come into contact with biological hazards such as animals, insects, and plants.

4.4.1 Animals

During site operations, animals such as dogs, cats, raccoons, skunks, mice, and snakes may be encountered. Workers shall use discretion and avoid all contact with animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed control technician.

4.4.2 Insects and Lyme Disease

Insects including bees, wasps, hornets, and spiders may be present at this site making the chance of a bite possible. Some individuals may have a severe allergic reaction to an insect bite or sting that may result in a life threatening condition. Any individuals who have been

bitten or stung by an insect should notify the SHSO. The following is a list of preventive measures:

- Apply insect repellent prior to fieldwork and/or as often as needed during the work shift.
- Wear proper protective clothing (work boots, socks, and light colored pants).
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Field personnel who may have insect allergies should provide this information to the SHSO prior to commencing work and shall have bee sting allergy medication on site.
- The SHSO will instruct the field crew in the recognition and procedures for encountering poisonous insects at the site.

Lyme disease is caused by infection from a deer tick that carries a spirochete (a spiral-shaped bacterium). During the painless tick bite, the spirochete may be transmitted into the bloodstream, which could lead to the worker contracting Lyme disease.

Lyme disease may cause a variety of medical conditions including arthritis, which can be treated successfully if the symptoms are recognized early and medical attention is received. Treatment with antibodies has been successful in preventing more serious symptoms from developing. Early signs may include a flu-like illness, an expanding skin rash, and joint pain. If left untreated, Lyme disease can cause serious nerve or heart problems, as well as a disabling type of arthritis.

Symptoms can include a stiff neck, chills, fever, sore throat, headache, fatigue, and joint pain. These flu-like symptoms commonly occur between May and October, when ticks are most active. A large expanding skin rash usually develops around the area of the bite. More than one rash may occur. The rash may feel hot and may be painful. Rashes vary in size, shape, and color, but the rash often has a red ring with a clear center, and the outer edges expand in size. It is easy to miss the rash and the connection between the rash and a tick bite. The rash may develop up to a month after the tick bites. Almost one-third infected with Lyme disease never get the rash.

4.4.3 Plants

The potential for contact with poisonous plants exists when performing fieldwork in undeveloped and wooded areas. Poison ivy, sumac, and oak may be present on the site.

Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring.

Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves that are velvety dark green on top and pale underneath. The branches of immature trees have a velvety “down.” Poison sumac has white, “hairy” berry clusters.

Poison oak can be present as a sparingly branched shrub. Poison oak is similar to poison ivy in that it has the same leaflet configuration; however, the leaves have slightly deeper notches.

Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin that needs first aid treatment. If you believe you have contacted one of these plants, notify the FOL/SHSO and immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.

4.4.4 Contact with Untreated Sewage

A large sewage treatment plant is located upriver of the project site. In the past, the treatment plant has discharged raw sewage into the Calumet River as a result of upsets in their system. As such, there is a possibility that our project personnel could contact untreated sewage and the typical pathogens contained therein—most notably Hepatitis A and tetanus—if incidental sewage discharges occur in the course of work. To address this hazard, all site personnel who have the potential of contacting river water will receive Hepatitis A and tetanus immunizations before mobilizing to the site. They will also be required to wash their hands at the end of work each day and before handling food. Contaminated work clothing will also be laundered.

5. ACTIVITY HAZARD ANALYSIS

The Activity Hazard Analysis (AHA) is a systematic way of identifying the potential health and safety hazards associated with major phases of work on the project and the methods to avoid, control, and mitigate those hazards. AHAs are developed for all activities as necessary, prior to start-up. The AHAs will be used to train work crews in proper safety procedures during phase preparatory meetings.

AHAs are included in Appendix D of this EHS Plan. AHAs have been developed for the following phases of work:

- Mobilization/demobilization
- Sediment Coring Operations
- Working on or over water
- Equipment Decontamination
- Conducting Topographic Surveys
- Core sample preparation

6. PERSONAL PROTECTIVE EQUIPMENT

The PPE specified in Table 6-1 represents the hazard analysis and PPE selection required by 29 CFR 1910.132. Specific information on the selection rationale for each activity can be found under Section 4.0 and Appendix D for AHAs. For the purposes of PPE selection, the PESM and SHSO are considered competent persons.

Modifications for initial PPE selection may also be made by the SHSO in consultation with the PESM. A written justification for downgrades will be provided to the PESM for approval as a field change request.

6.1 PPE ABBREVIATIONS

HEAD PROTECTION

HH = hard hat

HEARING PROTECTION

EP = ear plugs

EM = ear muffs

EYE/FACE PROTECTION

APR = full-face air purifying
respirator

GOG = goggles

MFS = mesh face shield

PFS = plastic face shield

SG = ANSI approved safety glasses
with side shields

FOOT PROTECTION

Neo = neoprene

OB = overboot

Poly = polyethylene coated boot

Rub = rubber slush boots

STB = leather work boots with steel toe

HAND PROTECTION

Cot = cotton

But = butyl

LWG = leather work gloves

Neo = neoprene

Nit = nitrile

Sur = surgical

BODY PROTECTION

WC = work clothes

Cot Cov = Cotton Coveralls

Poly = polyethylene coated Tyvek[®]
coveralls

Saran = saranex coated Tyvek[®]
coveralls

Tyvek = uncoated paper Tyvek[®]
coveralls

RESPIRATORY PROTECTION

Level D = No respiratory protection
required

Level C = Full face air purifying respirator
with N-99 cartridges

Level B = Full face air supplied respirator
with escape bottle

Table 6-1 summarizes the PPE required for each task.

Table 6-1. Personal Protective Equipment Selection

TASK	HEAD	EYE	FEET	HANDS	BODY	HEARING	RESPIRATOR
Mobilization/ Demobilization	HH, if overhead hazard	SG	STB	LWG	WC	As determined necessary by the SHSO	Level D
Sediment Core Sampling	HH	SG	STB + OB or Rub	Nit	WC + Poly as determined by SHSO	As determined necessary by the SHSO	Level D initially, Modified Level D as indicated and when needed to prevent dermal contact with sediments.
Core Sample Preparation	HH, if overhead hazard	SG	STB + OB or Rub	Nit	WC + Poly as determined by SHSO	As determined necessary by the SHSO	Level D initially, Modified Level D as indicated and when needed to prevent dermal contact with sediments.
Conducting Bathymetry/ Topographic surveys	N/A	N/A	STB + OB	N/A	WC + Tyvek coverall if poison oak is present	N/A	Level D or modified level D if poison oak is present.
Equipment Decontamination	N/A	GOG + PFS	STB + OB or Rub	Nit	WC + Poly as determined by SHSO	As determined necessary by the SHSO	Level D initially, Modified Level D as indicated and when needed to prevent dermal contact with sediments.

HH = hard hat
GOG = goggles
PFS = plastic face shield
STB = leather work boots with steel toe
OB = overboot
Nit = nitrile
LWG = leather work gloves
WC = work cloths
SHSO = Site Health and Safety Officer

6.2 OSHA REQUIREMENTS FOR PERSONAL PROTECTIVE EQUIPMENT

All PPE used during the course of this field activity must meet the following OSHA standards:

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1
Respiratory	29 CFR 1910.134	ANSI Z88.1
Head	29 CFR 1910.135	ANSI Z89.1
Foot	29 CFR 1910.136	ANSI Z41.1
Hand	29 CFR 1910.138	
Hearing	29 CFR 1910.95	
Protective Clothing	29 CFR 1910.132	

ANSI = American National Standards Institute

Because the concentration of contaminants in the sediments are not high enough to exceed OSHA Permissible Exposure Limits, even under worst case dust conditions (10 mg/m³ total dust), respiratory protection for airborne particulates will not be required on this project.

Due to the nature of the tasks involved and the size of the site, the SHSO will choose PPE on a daily basis depending on the operation, location, and the hazards involved in each task. The level of PPE protection will be upgraded or downgraded based on changes in site conditions. Several factors which may indicate the need to re-evaluate site conditions and PPE selection include the following:

- Encountering or handling contaminants other than those previously identified
- Commencement of a new work phase
- Change in job tasks during a work phase
- Change of season/weather
- Change in work scope that affects the degrees of contact with contaminants
- Change of ambient levels of contaminants

All major PPE changes must be approved in advance by the PESM.

The various levels of personal protective equipment referenced in this plan – Level D and Modified Level D – are described below:

Level D

If the potential for direct chemical contact is minimal (such as mobilizing equipment and surveying site), or if workers are going to be outside the exclusion and contamination reduction zones, then Level D PPE will be prescribed as follows:

- Cotton coveralls, leather gloves, hard hat, and safety glasses with side shields
- Chemical-resistant boots or leather work boots with steel toe
- High-intensity road vests when working near heavy equipment
- Optional disposable boot covers and chemical-protective gloves
- Hearing protection as required

Modified Level D

Modified Level D will be worn by those site workers who may come into direct skin contact with the contaminated sediments (such as when collecting core samples and examining and preparing core samples for laboratory analysis and shipment) without significant inhalation exposure. Modified Level D will consist of the following items:

- Disposable PolyTyvek coveralls or lightweight, reusable raingear
- Nitrile gloves and PVC steel-toe boots with optional latex booties
- Hard hats
- Safety glasses
- High-intensity road vests when working around heavy equipment
- Hearing protection as required

7. MONITORING

Ambient air measurements for volatile organic vapors, H₂S, combustible gas (methane), and benzene will be collected in the breathing zone of those site technicians engaged in the handling, examination, and preparation of the sediment core samples. Organic vapor levels will be measured with an Hnu Photoionization Detector. Whenever Hnu results indicate the presence of vapor contamination as described in the action level table (Table 7-1), additional differential-air sampling will be conducted using a colorimetric indicator tube sampler equipped with benzene sampling tubes.

To monitor the possible accumulation of flammable vapors in the sample prep area caused by the release of methane gas from the core samples, percent-LEL readings will be taken with a combustible gas/O₂ indicator (CGI). This CGI will also be equipped with an H₂S sensor to measure the concentration of hydrogen sulfide gas in the workplace air which may also be present in the core samples.

The SHSO or his designated technician will collect all air measurements regularly in the work area. Air monitoring results will be recorded in the site logbook. These results will also be made available for review by all site personnel.

Calibration and maintenance of monitoring equipment will be in compliance with the manufacturer's specifications and will be performed daily. Calibration records will be kept in the project health and safety files. Daily reports describing sampling activities will be drafted and the originals kept in the files with the other health and safety related documentation. Employees will be notified of any levels of concern by posting air monitoring results on the bulletin board.

The above-mentioned instrument readings will be compared to the actions levels listed in Table 7-1.

Table 7-1. Real-Time Air Monitoring Action Levels

Monitoring Instrument	Activity	Action Level	Site Action
Photoionization Detector	Core sample handling, examination, and preparation	>background but <10 ppm	Wear Modified Level D PPE. Monitor for benzene
	Sediment core sample collection as necessary	>10 ppm but <20 ppm	Stop work, leave sample prep area, mechanically ventilate space until ambient vapors are reduced to below action levels (i.e 10 ppm total vapor and 1 ppm benzene)
		>20 ppm	Stop work. Leave work area and call PESM.
Benzene Detector Tubes	Core sample handling, examination, and preparation	>0.5 ppm but <1 ppm	Wear Modified Level D PPE. Continue monitoring.
	Sediment core sample collection as necessary	>1 ppm	Stop work, leave sample prep area, mechanically ventilate space until benzene vapors are reduced to below 1 ppm.
Combustible Gas Indicator	Core sample handling, examination, and preparation	>19.5% O ₂ but <22% O ₂ <10% LEL	Wear Modified Level D PPE. Continue working.
	Sediment core sample collection as necessary	<19.5% O ₂ or >22% O ₂ >10% LEL	Stop work, leave sample prep area, mechanically ventilate space until %LEL and O ₂ levels are within safe limits
Hydrogen Sulfide Monitor	Core sample handling, examination, and preparation	Background to <20 ppm H ₂ S.	Wear Modified Level D PPE. Continue monitoring.
	Sediment core sample collection as necessary	>20 ppm H ₂ S	Stop work, leave sample prep area, mechanically ventilate space until H ₂ S concentrations are below 20 ppm.

7.1 NOISE MONITORING

Work areas or tasks that pose an exposure risk greater than 85 dBs will require hearing protection. If it becomes difficult to converse with crew members due to ambient noise levels, all personnel in this noise environment will be required to wear hearing protection.

7.2 TEMPERATURE EXTREMES MONITORING

Temperature extremes monitoring will be conducted in accordance with Foster Wheeler Environmental Health and Safety Program EHS 4-6. This program can be found in Appendix F.

8. ZONES AND COMMUNICATIONS

8.1 WORK ZONES

The project site will be divided into an exclusion zone (EZ), a contamination reduction zone, and a clean zone. The exclusion zone is defined as the area where contamination and other site hazards are either known or are likely to be present. The contamination reduction zone is where hazardous substances are removed from site personnel and their equipment as they exit the EZ. The clean zone is a non-contaminated area where support services, storage of non-hazardous materials, and administrative activities may occur. There will be no smoking, eating, or drinking within the exclusion or contaminant reduction zones. The zone locations will be based upon current knowledge of proposed site activities. It is possible that the zone configurations may be changed due to work plan revisions. Should this occur, the work zone figures will be adjusted accordingly, and documented through use of an FCR form.

Exclusion Zone

The EZ will include the vibracore floating work platform and core sample examination and preparation area. These areas will be identified and isolated in such a way as to avoid interference with operations by outside personnel. Isolation protocols may include use of ropes, barricades, temporary fencing, boundary tape, warning signs, or other distinguishable markers. All personnel entering the EZ will use the buddy system to maintain vigilance over each other and will wear the personal protective equipment specified in Section 6 of this plan. EZ workers will also have copies of their medical clearance and training records on file at the site.

Contamination Reduction Zone

A contamination reduction zone (CRZ) will be established between the support zone and the EZ and will be used for EZ entry and egress of personnel and emergency support services. The CRZ will contain a contamination reduction corridor that includes an area for decontamination of personnel and portable hand-held equipment, tools, and heavy equipment. All personnel and equipment must pass through the contamination reduction corridor when exiting the exclusion zone. Decontamination of personnel and equipment will

be accomplished as described in Section 8.2 below. Decontamination activities to be conducted in the CRZ will require personal protection as deemed necessary by the SHSO.

Support Zone

The support zone (SZ) is located in an uncontaminated area of the site adjacent to the EZ and CRZ. Site access and the majority of site operations will be controlled from this location. The SZ will contain provisions for team communications and serve as a staging area for equipment, office facilities, and emergency response resources. Safety equipment such as emergency eyewash, fire extinguisher, first aid kit, air horns and other equipment will be stored in the SZ and transported to work areas as necessary. No contaminated personnel or contaminated materials will be allowed in this zone except appropriately packaged and decontaminated environmental samples.

8.2 CONTAMINATION CONTROL

8.2.1 Personnel Decontamination Station

Good personal hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure.

8.2.2 Minimization of Contact with Contaminants

During completion of all site activities, personnel should attempt to minimize the degree of contact with contaminated materials. This involves a conscientious effort to keep “clean” during site activities. All personnel should minimize kneeling, splash generation, and other physical contact with contamination. This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

Field procedures will be developed to control overspray and runoff and to ensure that unprotected personnel working nearby are not affected.

8.2.3 Personnel Decontamination Sequence

Consideration will be given to prevailing wind directions so that the decontamination line, the support zone, and contamination reduction zone exit is upwind from the exclusion zone and the first station of the decontamination line. Personnel who are performing decontamination will remove all PPE used in the EZ and place the waste in drums/trash cans in the CRZ. Hand sanitizer or baby wipes shall be available for wiping hands and face.

Decontamination for site personnel wearing Level D PPE will consist of having each worker remove their hard hats, safety glasses, leather gloves, hearing protectors, PFDs, and outer protective garments prior to leaving the site and storing them in a clean area for reuse the next day.

Site personnel engaged in sediment coring and core sample preparation work while wearing Modified Level D PPE will be required to have their boots and gloves washed, rinsed, and removed before leaving the site. They will also remove their Poly-Tyvek coveralls and place them in a plastic bag for disposal. Re-usable pvc raingear, if worn, will be rinsed clean with water, removed, and stored on site for later use.

Personnel decontamination will be conducted in a CRZ situated adjacent to and contiguous with the EZ. A large wash tub will be placed in the CRZ for workers to stand in while their outer protective clothing is washed and rinsed. Scrub brushes and soap solution may be used to remove mud and soil from clothing.

The SHSO will ensure that the above-mentioned decontamination procedures are effectively controlling the spread of contamination in the work area by periodically inspecting the recently cleaned clothing and equipment for evidence of residual contamination. The work area will also be examined to detect any sign of contamination outside of the work zones. Should it become apparent that contamination is being dispersed into clean areas of the site, work activities will cease until more effective decon methods can be devised.

8.2.4 Emergency Decontamination

If circumstances dictate that contaminated clothing cannot be readily removed, remove gross contamination, wrap injured personnel with clean garments/blankets to avoid contaminating other personnel or transporting equipment. If the injured person can be moved, he/she will be moved to the EZ boundary. Decontamination, as described above, will be performed by site personnel before emergency responders handle the victim.

8.2.5 Hand-held Equipment Decontamination

Hand-held equipment includes all monitoring instruments, samples, hand tools, and notebooks. The hand-held equipment is dropped at the first decontamination station to be decontaminated by one of the decontamination team members. These items must be decontaminated or discarded as waste prior to removal from the EZ.

To aid in decontamination, monitoring instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants. The instruments will be wiped clean using wipes or paper towels if contamination is visually evident. Decontamination procedures for sampling equipment, hand tools, etc., shall include the use of steam cleaning or a detergent wash, as appropriate for the site conditions.

8.3 COMMUNICATIONS

The following communications equipment shall be specified as appropriate:

- Telephones – A cellular telephone will be located in the SZ for communication with emergency support services/facilities and the home office.
- Hand Signals – Field teams shall use hand signals along with the buddy system. The entire field team shall know them before operations commence and their use covered during site-specific training. Typical hand signals include the following:

Signal	Meaning
Hand gripping throat	Out of air, can't breathe
Grip on a partner's wrist or placement of both hands around a partner's waist	Leave area immediately, no debate
Hands on top of head	Need assistance
Thumbs up	Okay, I'm all right, I understand
Thumbs down	No, negative

9. MEDICAL SURVEILLANCE PROCEDURES

All contractor and subcontractor personnel performing field work where potential exposure to contaminants exists at the site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120(f). Site workers who may come into contact with river water will have current immunizations for Hepatitis A and tetanus.

The Foster Wheeler Environmental Corporate Medical Surveillance Program is described in detail in Foster Wheeler Environmental Health and Safety Program EHS 4-5. The Corporate Medical Consultant is Greaney Medical Group in California.

9.1 MEDICAL SURVEILLANCE REQUIREMENTS

A physician's medical release for work will be confirmed by the SHSO before an employee can work in the EZ. The examination will be taken annually or biennially (with physician approval) and upon termination of hazardous waste site work if the last examination was not taken within the previous 6 months. Additional medical testing may be required by the PESM in consultation with the Corporate Medical Consultant and the SHSO if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other site conditions warrant further medical surveillance.

9.2 MEDICAL DATA SHEET

A medical data sheet is provided in Appendix E, EHS Forms. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the site. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need-to-know basis.

10. SAFETY CONSIDERATIONS FOR SITE OPERATIONS

10.1 GENERAL

The FOL and/or SHSO will be present at the site at all times during work activities and shall provide all monitoring and health and safety support in order to ensure the adequacy of protective equipment and safety procedures.

10.2 SAFETY CONSIDERATIONS DURING FIELD OPERATIONS

During all activities, personnel shall strictly adhere to the following procedures:

- The buddy system or line of sight will be used during intrusive work.
- If field personnel perceive an unsafe condition or situation, the FOL/SHSO will be notified immediately.
- All site personnel shall be aware of the Foster Wheeler Environmental work rules (see Appendix H).

10.3 WORKING ON OR IN WATER

Site personnel shall use caution when site work requires wading in water, working on small boats, or working on amphibious vehicles. Where necessary, personnel shall wear waterproof knee boots or hip waders and ensure that water levels do not exceed the height of the boots or waders. Personnel wading in water shall have a means of rescue present prior to starting work, including a throwable flotation device attached to a rope or a small boat available. If it becomes necessary to use a boat for sampling purposes, personnel will follow the safety procedures contained in the Foster Wheeler Environmental Health and Safety Program EHS 6-7, Boating, which is included as Appendix C. Personnel working in, on, or over the water will be required to wear a Coast Guard Approved personal flotation device at all times.

10.4 CORING OPERATIONS

Because of the inherently hazardous nature of coring operations, and the combination of working over water, safety and accident prevention are crucial when these operations are performed. Most accidents during coring occur as a direct result of lack of training and

supervision, improper handling of equipment, and unsafe work practices. Hazards include, but are not limited to, the following:

- Caught between vibracore head and core tube during attachment of tubes causing lacerations or crushing injury to hand and fingers
- Slips, trips, and falls, causing injury or drowning
- Struck by dropped objects or swinging objects during winch use, causing lacerations, contusions, or broken bones
- Struck by disconnected hose, causing lacerations, contusions, or serious injury
- Stuck by splashing mud, water inside tube or flying particles, causing eye injury
- Destabilization of support frame due to unstable conditions working on uneven/soft surfaces

10.5 BIOLOGICAL HAZARDS

Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life threatening condition. Any individuals who have been bitten or stung by an insect should notify the FOL/SHSO. The following is a list of preventive measures.

- Apply insect repellent prior to fieldwork and/or as often as needed throughout the work shift.
- Wear proper protective clothing (work boots, socks, and light colored pants).
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Field personnel who may have insect allergies should provide this information to the SHSO prior to commencing work and shall have bee sting allergy medication on site.

It is recommended that personnel check themselves when in areas that could harbor deer ticks. They should also wear light colored clothing and visually check themselves and their buddy when coming from wooded or vegetated areas. If a tick is found biting an individual, the SHSO should be contacted immediately. The tick can be removed by pulling gently at the head with tweezers. The employee will be offered the option for medical treatment by a physician, which typically involves prophylactic antibiotics. If personnel feel sick or have signs similar to those above, they should notify the SHSO immediately.

Control measures to prevent Lyme disease include the following:

- Perform a self/buddy check of neck, hairline, groin and body after working in areas that may contain deer ticks.
- Wear light colored Tyvek clothing.
- If a tick is found, remove it by pulling gently at the head with tweezers. The affected area should then be disinfected with an antiseptic wipe.
- Report any of the above symptoms and all tick bites to the SHSO for evaluation. Employees bitten by deer ticks during the course of employment will be offered a medical examination.

11. DISPOSAL PROCEDURES

All discarded materials, waste materials, or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left on the site. All potentially contaminated materials (e.g., clothing, gloves, etc.) will be bagged or drummed as necessary, labeled, and segregated for disposal. All non-contaminated materials shall be collected and bagged for appropriate disposal as non-hazardous solid waste. Additional waste disposal procedures may be developed in conjunction with the Foster Wheeler Environmental regulatory affairs department, as applicable. During the disposal procedures, all personnel shall comply with the Waste Management Plan.

12. EMERGENCY RESPONSE PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures that are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures.

12.1 RESPONSIBILITIES

12.1.1 Project Environmental and Safety Manager

The PESM oversees and approves the Emergency Response/Contingency Plan and performs audits to determine that the plan is in effect and that all pre-emergency requirements are met. The PESM acts as a liaison to applicable regulatory agencies and notifies OSHA of reportable accidents.

12.1.2 Emergency Coordinator

The Emergency Coordinator is the SHSO. In the event of an emergency, the Emergency Coordinator shall make contact with local emergency response personnel. In these contacts, the Emergency Coordinator will inform response personnel about the nature of work on the site, the type of contaminants and associated health or safety effects, and the nature of the emergency, particularly if it is related to exposure to contaminants.

The Emergency Coordinator shall review this plan, verify the emergency phone numbers on Table 12-1, and review the hospital route prior to beginning work on site. See Appendix G of this EHS Plan for the hospital route map. The Emergency Coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator shall implement the Emergency Response/Contingency Plan whenever conditions at the site warrant such action.

12.1.3 Site Personnel

Site personnel are responsible for knowing the Emergency Response/Contingency Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency.

12.2 COMMUNICATIONS

A variety of communication systems may be utilized during emergency situations. These are discussed in the following sections.

During an emergency, the primary form of communication between field groups in the EZ and the Emergency Coordinator will be verbal communications. During an emergency situation, the lines will be kept clear so that all field teams can receive instructions.

12.2.1 Telephone Communications

A cellular telephone will be available on site.

12.2.2 Air Horns

Air horns will be used to alert site personnel of emergencies. The following signals will be used:

- Two short blasts = shut down equipment, await instructions
- Three short blasts = injured employee, first-aid providers respond
- One continuous blast = site evacuation

The procedure to activate the air horns consists of depressing the air horn button or switch while pointing it in the direction of the area to be signaled. Air horns should be tested at least monthly to ensure that they are working properly.

12.2.3 Hand Signals

Field teams will employ hand signals when necessary for communication during emergency situations. Hand signals are found in Section 8.3.

12.3 PRE-EMERGENCY PLANNING

Emergency telephone numbers should be readily available in the immediate work area and in the SZ in order to deal with any emergency that might occur during remedial activities at the site. These telephone numbers are presented in Table 12-1. Hospital route maps will also be

readily available. The emergency phone numbers listed are preliminary. Upon mobilization, the SHSO shall verify all numbers and document any changes in the site logbook. Any changes shall also be documented with a field change request form.

Each person who will be working on the site or observing the operations will be asked to complete a medical data sheet before fieldwork commences. These data sheets will be filled out during the initial site safety-training meeting and will be kept on the site. In the event of an incident where a team member has to be taken to a hospital, a copy of his/her medical data sheet will be presented to the attending physician.

12.4 EMERGENCY MEDICAL TREATMENT

The procedures and rules in this EHS Plan are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the FOL/SHSO immediately. First-aid equipment will be available on site.

During the site safety briefing, project personnel will be informed of the location of the first aid station(s) that has been set up. Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

If personnel are transported to the hospital, the FOL/SHSO will provide a copy of the Medical Data Sheet to the paramedics and treating physician. Only in **non-emergency** situations will an injured person be transported to the hospital by means other than an ambulance.

12.5 EMERGENCY SITE EVACUATION ROUTES AND PROCEDURES

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs at the work area, including but not limited to fire, explosion, or significant release of toxic gas into the atmosphere, immediate evacuation of all personnel is necessary due to an immediate or impending danger. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at a pre-determined location.

As field activities at this location are anticipated to be limited to several weeks, evacuation drills may be performed.

Table 12-1. Emergency Telephone Numbers

Emergency Service	Telephone Number
Police	911
Fire	911
Ambulance	911
St. Catherine's Hospital	219-392-1700
EPA National Response Center	800-424-8802
Poison Control Center	800-252-5655
Mark Herrenkohl, Project Manager	360-961-7889
Steve Frost, PESM	425-482-7702

12.6 FIRE PREVENTION AND PROTECTION

In the event of a fire or explosion, procedures will include immediately evacuating the work area, the Emergency Coordinator will immediately notify the local fire and police departments. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

Adhering to the following precautions will help to prevent fires:

- Good housekeeping and storage of materials
- Storage of flammable liquids and gases away from oxidizers
- No smoking in the exclusion zone or any work area
- No hot work without a properly executed hot work permit
- Shutting off engines to refuel
- Grounding and bonding metal containers during transfer of flammable liquids
- Use of Underwriters Laboratory approved flammable storage cans

- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers, and near all hot work activities
- Monthly inspections of all fire extinguishers.

12.7 OVERT CHEMICAL EXPOSURE

The following are standard procedures to treat chemical exposures. Other specific procedures detailed on the Material Safety Data Sheets (MSDS) or recommended by the Corporate Medical Consultant will be followed, when necessary. If first aid or emergency medical treatment is necessary, the Emergency Coordinator will contact the emergency facilities.

Skin and Eye Contact:	Use copious amounts of soap and water. Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination. Skin should also be rinsed for 15 minutes if contact with caustic or acid chemical should occur.
Inhalation:	Move to fresh air. Decontaminate and transport to hospital or local medical provider.
Ingestion:	Decontaminate and transport to emergency medical facility.
Puncture Wound or Laceration:	Decontaminate and transport to emergency medical facility.

12.8 DECONTAMINATION DURING MEDICAL EMERGENCIES

If emergency life-saving first aid and/or medical treatment are required, normal decontamination procedures may need to be abbreviated or postponed. The SHSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on site, a plastic barrier between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material, which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

12.9 ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

- Project Environmental and Safety Manager, Steve Frost, 425-482-7702.
- Project Manager, Mark Herrenkohl, 360-961-7889.
- The employer of any injured worker who is not a Foster Wheeler Environmental employee.

Written confirmation of verbal reports are to be submitted within 24 hours. The accident/incident report is provided in Appendix E, EHS Forms. If the employee involved is not a Foster Wheeler Environmental employee, his/her employer shall receive a copy of the report.

12.10 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SHSO in conjunction with the FOL, will determine if work can continue without potentially risking the safety of all field workers.

Some of the items to be considered prior to determining if work should continue include the following:

- Potential for cold, stress and cold-related injuries
- Treacherous weather-related working conditions (hail, rain, snow, ice, and/or high winds)
- Limited visibility (fog)
- Potential for floods or high current conditions
- Potential for electrical storms.

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The SHSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

12.11 SPILL CONTROL AND RESPONSE

All small hazardous spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust, or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly disposed as hazardous waste. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill. The FOL/SHSO should take the following steps:

1. Determine the nature, identity, and amounts of major spill components.
2. Make sure all unnecessary persons are removed from the spill area.
3. Notify appropriate response teams and authorities.
4. Use proper PPE in consultation with the SHSO.
5. If a flammable liquid, gas, or vapor is involved, remove all ignition sources and use nonsparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.).
6. If possible, try to stop the leak with appropriate material.
7. Remove all surrounding materials that can react or compound with the spill.
8. Notify Joe Walsh, Livingston Office Regulatory Affairs, 973-630-8376.

12.12 EMERGENCY EQUIPMENT

The following minimum emergency equipment shall be kept and maintained on site.

- Industrial first aid kit
- Bloodborne pathogen kit
- Portable eye washes
- Fire extinguishers (one per vehicle and heavy equipment)
- Absorbent material

12.13 POSTINGS

The following information shall be posted or readily visible and available at conspicuous locations throughout the site.

- Emergency telephone numbers
- Hospital Route Map

12.14 RESTORATION AND SALVAGE

After an emergency, prompt restoration of utilities, fire protection equipment, medical supplies, and other equipment will reduce the possibility of further losses. Some of the items that may need to be addressed include the following:

- Refilling fire extinguishers
- Refilling medical supplies
- Recharging eyewashes and/or showers
- Replenishing spill control supplies
- Replacing used air horns

13. TRAINING REQUIREMENTS

13.1 HAZWOPER TRAINING

In accordance with Foster Wheeler Environmental corporate policy, and pursuant to 29 CFR 1910.120, site personnel shall have had 40-hour General Site Worker training, 3-day supervised on-the-job training, and 8-hour refresher training (if it has been at least 1 year since the initial 40-hour training of HAZWOPER). Personnel who have not met the requirements for initial training shall not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

13.2 SITE-SPECIFIC TRAINING

Prior to commencement of field activities, all field personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring, and equipment for the site operations. It will include site and facility layout, hazards, and emergency services at the site, and will highlight all provisions contained within this EHS Plan. This training will also allow field worker, to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity. Boat operators will have demonstrated skills, experience, and/or appropriate training in operating the vessels (work boats and drilling platform) used on this project.

13.3 ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given daily on-site health and safety briefings by the FOL/SHSO to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices, or the site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

13.4 FIRST AID AND CPR

The SHSO and at least one other site worker shall have First Aid and CPR training in order to ensure that emergency medical treatment is available during field activities. A list of first aid qualified personnel will be posted at the site. The training will be consistent with the requirements of the American Red Cross Association.

13.5 HAZARD COMMUNICATION

Hazard communication training will be provided in accordance with the requirements contained in the Foster Wheeler Environmental Health and Safety Program EHS 4-2.

14. LOGS, REPORTS, AND RECORDKEEPING

The following is a summary of required health and safety logs, reports, and recordkeeping for the Project.

14.1 FIELD CHANGE REQUEST

The Field Change Request Form is to be completed for initiating a change to the EHS Plan. The PESM and Project Manager approval is required. The original will be kept in the project file.

14.2 ON-SITE LOG

A log of personnel on site each day will be kept by the SHSO. Originals will be kept in the project file.

14.3 HEALTH AND SAFETY REPORTS

The SHSO shall complete and submit Weekly Health and Safety Reports to the PESM. These reports are provided in Appendix E, EHS Forms.

14.4 ACCIDENT/INCIDENT REPORTS

A Foster Wheeler Environmental accident/incident report must be completed following procedures given in Section 12.9 of this EHS Plan. The originals will be sent to the Regional Records Coordinator for maintenance by Foster Wheeler Environmental. Copies will be distributed as stated. A copy of the forms will be kept in the project file.

14.5 MATERIAL SAFETY DATA SHEETS

MSDSs will be obtained and kept on file at the project site for each hazardous chemical brought to, used, or stored at the site. The MSDS will be kept in the project file.

15. FIELD TEAM REVIEW

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the EHS Plan for site activities conducted on the West Branch of the Calumet River, East Chicago, Indiana. It is maintained on site by the FOL/SHSO as a project record.

Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the EHS Plan and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	Date

APPENDIX A

FIELD CHANGE REQUEST FORM

**FOSTER WHEELER ENVIRONMENTAL
FIELD CHANGE REQUEST FORM**

PROJECT: _____

CHANGE NUMBER: _____

PROJECT LOCATION: _____

DESCRIPTION OF CHANGE: _____

REASON FOR CHANGE: _____

RECOMMENDED DISPOSITION: _____

SITE MANAGER: _____
Signature Date

PROGRAM HEALTH AND SAFETY MANAGER:

Signature Date

DISTRIBUTION: Project Environmental and Safety Manager ____
Project Manager ____
Quality Assurance Representative ____
FOL/SHSO ____

EHS PLAN FIELD CHANGE

Field Change Number: _____ Date Effective: _____

Pen and Ink changes to be made in the EHS Plan to alert the reader of this change:

Reason for the change to be incorporated into the EHS Plan:

Text of change to be incorporated:

FIELD CHANGE RECORDS

Record of Field Changes:

Initial for attaching any Field changes to this EHS Plan. Enter the Field Change Number and Date Issued.

File the completed field changes to this EHS Plan at the end as attachments. Make PEN and INK changes in the text to alert the reader to the changes that are required in the Field Change.

FIELD CHANGE NUMBER	DATE ENTERED	SYNOPSIS OF CHANGE	INITIAL

APPENDIX B

CHEMICAL DATA SHEETS

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Trade Name:	Arsenic	Formula:	As
Molecular Weight:	74.91	CAS #:	7440-38-2

II HAZARDOUS INGREDIENTS

PEL (mg/m ³): OSHA: 0.01	ACGIH: 0.2
SARA Title III Sect. 313 Chem: Yes	Weight %: 99.99+

III PHYSICAL DATA

Boiling Point (°C):	Not applicable	Melting Point (°C):	Sublimes at 613
Vapor Density (Air=1):	Not applicable	Evaporation Rate:	N/A
Solubility in H ₂ O:	Insoluble	pH:	N/A
Appearance and Odor:	Gray-black metal, odorless.	Specific gravity (H ₂ O=1):	5.72

IV FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): N/A	Autoignition Temp (°C): N/A
Flammability: LEL: No data	UEL: No data

Special Fire Fighting Procedures: Use NIOSH/MSHA approved self-contained breathing apparatus and full protective clothing if involved in fire.

Fire Extinguishing agents Recommended: No specific agents recommended.

Extinguishing Media: N/A

Unusual Fire and Explosion Hazards: N/A

V HEALTH HAZARD INFORMATION

Primary Routes of Entry: Inhalation

Carcinogenicity: IARC classifies arsenic and certain arsenic compounds as Group 1 carcinogens (carcinogenic to humans). NTP classifies these materials as "...substances, and technological or manufacturing processes that are known to be carcinogenic." OSHA classifies inorganic arsenic and its compounds as carcinogens.

Acute Overexposure (symptoms and effects): Chronic overexposure to arsenic compounds may cause skin and eye irritation, peripheral neuritis of the hands and feet, and a increased risk of lung and skin cancer. Symptoms of chronic toxicity include weight loss, nausea, diarrhea, weakness, loss of appetite and skin lesions.

Medical Conditions Possibly Aggravated: Diseases of the lung, liver, kidneys, and nervous systems.

EMERGENCY AND FIRST AID PROCEDURES:

SKIN AND EYES: Flush with plenty of water. If symptoms develop, consult a physician.

INHALATION: Remove from exposure; place individual under care of a physician.

INGESTION: Induce vomiting in conscious individual and call a physician.

VI REACTIVITY DATA

Stability: Stable

Incompatibility (Material to Avoid): Halogen gases, halides, halogenates, potassium nitrate or permanganate or peroxides may cause a violent reaction or explode.

Hazardous Decomposition Products: At temperatures above the melting point, metal oxide fumes may be evolved. Under reducing conditions (i.e. any strong acid or base plus an active metal) or in the presence of nascent hydrogen, highly toxic arsine gas may be evolved.

Hazardous Polymerization: Will not occur

Conditions to Avoid: Not applicable

VII SPILL OR LEAK PROCEDURES

Steps to Be Taken in Case Material Is Released or Spilled: Any method which keeps dust to a minimum is acceptable. Vacuuming is preferred for dust. Use approved respiratory protection if possibility of dust/fume exposure exists. Do not use compressed air for cleaning.

Waste Disposal Method: If hazardous under 40 CFR 261, Subparts B and C, material must be treated or disposed in a facility meeting the requirements of 40 CFR 264 or 265. If non-hazardous, material should be disposed in a facility meeting the requirements of 40 CFR 257.

RCRA Status of Unused Material: If discarded in unaltered form, material should be tested to determine if it must be classified as a hazardous waste for disposal purposes. Under specified circumstances, application can be made to the EPA Administrator to have a particular waste designated non-hazardous.

Regulated by DOT?: Arsenic is regulated as a Poison B Hazardous Material.

VIII SPECIAL PROTECTION INFORMATION

Respiratory Protection: Where airborne exposures may exceed OSHA/ACGIH permissible air concentrations, the minimum respiratory protection recommended is a negative pressure air purifying respirator with cartridges that are NIOSH/MSHA approved against dust, fumes and mists having a TWA less than 0.05 mg/m³

Eye and Face: Safety glasses recommended where the possibility of getting dust particles in eyes exists.

Other Clothing and Equipment: Full protective clothing is recommended for exposures that exceed permissible air concentrations. All contaminated clothing should be removed before leaving plant premises.

IX SPECIAL PRECAUTIONS

Normal Handling: Use of approved respirators is required for applications where adequate ventilation cannot be provided. Activities which generate dust or fume should be avoided. When melted, the temperature should be kept as low as possible.

Personal Hygiene: Avoid inhalation or ingestion. Practice good housekeeping and personal hygiene procedures. No tobacco or food in the work area. Wash thoroughly before eating or smoking. Shower and change clothes at end of work shift. Do not wear contaminated clothing home. Do not blow dust off clothing with compressed air.

Engineering Controls: Local exhaust ventilation is recommended for dust and/or fume generating operations where airborne exposures may exceed permissible air concentrations.

Special Precautions/Procedures/Label Instructions: Where airborne arsenic exposures may exceed the OSHA action level and PEL, refer to the OSHA Arsenic Standard 29 CFR1910.1018.

Label signal word: DANGER

Prepared by: S. Dierks

Revised Date: June 1993

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Trade Name: Nickel
Chemical Nature: Metallic Element

Synonym: Nickel Metal Products
Formula: Ni

II HAZARDOUS INGREDIENTS

TLV (Units): 99.9% by Wt 0.1 mg/m³ TLV

III PHYSICAL DATA

Boiling Point 760 mm Hg: 2730 °C
Specific Gravity: 8.908 g/cm³
Appearance and Odor: Malleable, silvery metal

Melting Point: 1453 °C
Solubility in H₂O: Insoluble

IV FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): None
Flammable Limits: Upper: N/A Lower: N/A

Autoignition Temperature: N/A

Extinguishing Media: Non-flammable in form of metal pieces, wire or foil. If involved in a fire use dry sand, dry ground Dolomite, dry chemical extinguishing agents.

Special Fire Fighting Procedures: If involved in a fire wear NIOSH/MSHA approved self-contained breathing apparatus, flame and chemical resistant protective clothing, hat, gloves and boots. If without risk move material out of fire area.

Unusual Fire & Explosion Hazard: Flammable only in dust or powder form.

V HEALTH HAZARD INFORMATION

Threshold Limit Value: 0.1 mg/m³

Effects of Over Exposure: May cause dermatitis in sensitive individuals. Ingestion may cause intestinal disorders. Irritant via eye contact and inhalation.

Chromium and nickel and their compounds are listed in the 3rd annual report on carcinogens, as prepared by the National Toxicology Program (NTP). Exposure to high concentrations of dust and fumes can cause sensitization dermatitis, inflammation and/or ulceration of upper respiratory tract and possibly cancer of nasal passages and lungs. Recent epidemiological studies of workers melting and working alloys containing nickel/chromium have found no increased risk of cancer.

EMERGENCY AND FIRST AID PROCEDURES:

EYES: Flush with water, 15 minutes.

SKIN: Wash skin with soap and plenty of water.

INHALATION/INGESTION: Immediately seek medical attention.

VI REACTIVITY DATA

Stability: Stable

Incompatibility (Material to Avoid): Hydrochloric acid, Sulfuric acid, Nitric acid.

Hazardous Decomposition Procedures: None

Hazardous Polymerization: Will not Occur

VII SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled: Wearing respiratory protection and protective clothing, sweep up spillage. Transfer to a glass or metal container and submit or retain for disposal or salvage.

Waste Disposal Method: In accordance with all applicable Federal, State, and local regulations.

VIII SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type): NIOSH/MSHA approved.

Ventilation: Local not required

Eye Protection: Safety goggles

Protective Gloves: Heavy gloves

Other Protective Equipment: Lab coats and aprons.

IX SPECIAL PRECAUTIONS

Other Handling and Storage Conditions: Stable in air, however powders will burn in oxygen forming Nickel oxides. Keep away from open flame.

Prepared by: S. Dierks

Dated: November 1989

MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION

Trade Name: Mercury
CAS #: 7439-97-6

Formula: Hg

II HAZARDOUS INGREDIENTS

Mercury (Metallic Mercury, Quicksilver)
OSHA PEL: 0.1 mg Hg/m³

%: 100
ACGIH TLV: 0.05 mg Hg/m³ TWA

III PHYSICAL DATA

Boiling Point: 675 °F (357 °C)
Specific Gravity (H₂O=1): 13.6
Vapor Density (Air=1): 7.0
Appearance and Odor: Silvery-White, Heavy Mobile, liquid metal.

Melting Point: -38 °F (-39 °C)
Vapor Pressure: 0.0012 mm Hg @ 20 °C
Solubility in H₂O: Insoluble

IV FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): N/A
Flammable Limits: N/A

Autoignition Temperature: N/A

Extinguishing Media: Dry chemical, Carbon Dioxide, Water spray or foam (1984 Emergency Response Guidebook, DOT P 5800.3)
Special Fire Fighting Procedures: For larger fires, use water spray, fog or alcohol foam (1984 Emergency Response Guidebook, DOT P 5800.3)

Firefighting: Move containers from area if possible. Cool containers exposed to flames with water from side until well after fire is out (1984 Emergency Response Guidebook, DOT P 5800.3). Use agents suitable for type of fire.

Unusual Fire & Explosion Hazard: Use water in flooding amounts as a fog. Avoid breathing corrosive and poisonous vapors. Keep upwind.

V HEALTH HAZARD INFORMATION

Elemental Hg, liquid and vapor, is toxic due to its liquid solubility, lack of charge, and membrane permeability. Inhaled vapors (80%) diffuse rapidly through alveolar membranes into the blood and are systemically transported to body tissues, including the brain. Exposure to high conc. (>1.2 mg/m³) of vapors for brief periods can cause pneumonitis, chest pains, dyspnea, coughing; Later stomatitis, gingivitis, and salivati on occur. Hg can be absorbed slowly through the skin. Chronic symptoms involve the CNS with tremors and various neuropsychiatric disturbances. The TLV would be exceeded if the contents of a small Hg clinical thermometer were dispersed in a closed 100' X 100' X 15' room. GI uptake of Hg is low (<5%).

Routes of Entry:

Skin Contact: Irritant/Sensitizer/Neurotoxin/Nephrotoxin. Acute Exposure: May cause redness and irritation. Sensitization Dermatitis may occur in previously exposed workers. Substance may be absorbed through intact skin causing anuria.

Eye Contact: Irritant. Acute Exposure: Contact may cause irritation. Solutions are corrosive and may cause corneal injury or burns. Chronic Exposure: Mercury may be deposited in the lens of the eye, causing visual disturbances.

Ingestion: Neurotoxic/Nephrotoxic. **Acute Exposure** - When ingested, necrosis begins immediately in the mouth, throat, esophagus, and stomach. Within a few minutes, violent pain, profuse vomiting, and severe purging may occur. Patient may die within a few minutes from fluid/electrolyte losses and peripheral vascular collapse, but death (from uremia) is usually delayed 5 to 12 days.

Inhalation: Irritant/Sensitizer/Neurotoxin. 28 MG/M3 immediately dangerous to life or health. **Acute Exposure** - Inhalation of high concentration of mercury vapor can cause almost immediately dyspnea, cough, fever, nausea and vomiting, diarrhea, stomatitis, salivation and pulmonary edema, and pneumothorax. Syndrome is often fatal in children. Acidosis and renal damage with renal failure may occur. Inhaling volatile organic mercurials in high concentrations causes metallic taste, dizziness, clumsiness, slurred speech, diarrhea, and sometimes, fatal convulsions. **Chronic Exposure** - Inhalation of mercury vapor, dusts, over a long period causes mercurialism. Findings extremely variable & include tremors, salivation, stomatitis, loosening of teeth, blue lines on gums, pain & numbness in extremities, nephritis, diarrhea, anxiety, headache, weight loss, anorexia, mental depression, insomnia, irritability & instability, hallucinations and evidence of mental deterioration.

EMERGENCY AND FIRST AID PROCEDURES:

EYE CONTACT: Flush with running water for 15 minutes. Including under eyelids.

SKIN: Remove contaminated clothing. Wash affected area with soap and water.

INHALATION: Remove to fresh air. Restore and/or support breathing as needed. Administer O2 for chem. pneumonitis.

INGESTION: Gastric lavage with 5% solution of sodium formaldehyde sulfoxylate in the stomach. Seek medical assistance for further treatment, observation and support.

VI REACTIVITY DATA

Stability: Stable

Incompatibility: Acids

Conditions to Avoid: Thermal decomposition.

Hazardous Polymerization: Will not occur

Hazardous Decomposition Products: Hydrogen selenide, mercury oxides.

Other: No data

VII SPILL AND LEAK PROCEDURES

Mercury evaporates very slowly. Spilled Hg forms many tiny globules that will evaporate faster than a single pool and can develop a significant concentration of vapors in an unventilated area. Such vapors can be poisonous, especially if breathed over a long period of time. Heated Hg evolves high levels of toxic vapors.

DO NOT TOUCH SPILLED MATERIAL. Stop leak if you can do it without risk. For small spills, take up with sand or other absorbent material and place into containers for later disposal. A mercury spill kit may also be used for small spills in the workplace. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

VIII SPECIAL PROTECTION INFORMATION

Respiratory Protection: Self-contained breathing apparatus can be used up to 5 mg/m³ with a full face piece above 1 mg/m³. Positive pressure-type air supplied breathing equipment has been recommended above 5 mg/m³.

Ventilation: Provide adequate exhaust ventilation to meet TLV requirements in the workplace. Operations requiring an exposed Hg surface should reduce the temp. of Hg to limit vaporization and minimize vapor exposure by using a local exhaust.

Protective Gloves: Wear rubber gloves.

Protective Clothing: Wear protective clothing appropriate for the work situation. Separate work and street clothing. Store work clothing in special lockers. Showers to be taken before changing to street clothes.

Other Protective Equipment: Provide replacement and periodic medical exams for those regularly exposed to Hg, with emphasis directed to CNS, skin, lungs, liver, kidneys and G.I. tract.

IX SPECIAL PRECAUTIONS

Store in closed unbreakable containers (polyethylene) in a cool, dry, well-ventilated area away from sources of heat. Protect containers from physical damage.

Prepared by: S. Dierks

Dated: April 1993



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View Section:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16**CHEM SERVICE INC**

HEPTACHLOR, F100

SECTION 1 : CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MSDS Name: HEPTACHLOR, F100

Manufacturer Name: CHEM SERVICE INC

Address:

Box: 3108

City: WEST CHESTER

State: PA

Zip: 19381

Country: US

Business Phone: 215-692-3026

For information in North America, call: 215-692-3026

Health Phone: 215-692-3026

Manufacturer MSDS Creation Date:

03/17/1992

[To Top of page](#)**SECTION 2 : COMPOSITION, INFORMATION ON INGREDIENTS**

Chemical Name	CAS#	Percent	
4,7-METHANOINDENE, 1,4,5,6,7,8,8-HEPTACHLORO- 3A,4,7,7A-TETRAHYDRO-; (HEPTACHLOR) (SARA 313) (CERCLA)	76-44-8	N/K	

RTECS:

PC0700000

OSHA PEL TWA: 0.5 PPM, S

ACGIH TLV TWA: 0.05 PPM, A3, S

ACGIH STEL/Ceiling: N/P

Comments:

Other REC Limits: N/K ; EPA Rpt Qty: 1 LB ; DOT Rpt Qty: 1 LB ; Ozone Depleting Chemical:
N ;

Chemical Name	Percent
SUPP DATA: POIS CONTROL CENTER IMMEDIATE IF NEC. DO NOT ADMIN LIQUIDS/INDUCE VOMITING TO AN UNCON/CONVULSING PERS. (ING 3)	N/K

RTECS:

9999999ZZ

OSHA PEL TWA: N/K (FP N)

ACGIH TLV TWA: N/K (FP N)

ACGIH STEL/Ceiling: N/P

Comments:

Other REC Limits: N/K ;

Chemical Name	Percent
ING 2: IF PATIENT IS VOMIT - WATCH CLOSELY TO MAKE SURE AIRWAY DOES NOT BECOME OBSTRUCTED BY VOMIT. GET MED ATTN IF NEC.	N/K

RTECS:

9999999ZZ

OSHA PEL TWA: NOT APPLICABLE

ACGIH TLV TWA: NOT APPLICABLE

ACGIH STEL/Ceiling: N/P

Comments:

Other REC Limits: N/K ;

[To Top of page](#)**SECTION 3 : HAZARDS IDENTIFICATION****Applies to all Ingredients.:**

Route of Exposure:

Inhalation: YES Skin: YES Ingestion: YES

Potential Health Effects:

CONTACT LENSES SHOULD NOT BE WORN IN THE LABORATORY. ALL CHEMICALS
SHOULD BE CONSIDERED HAZARDOUS - AVOID DIRECT PHYSICAL CONTACT!
SUSPECTED CARCINOGEN - MAY PRODUCE CANCER. MAY BE ADVERSE HEALTH EFFECT S.

CAN CAUSE NERVOUS SYSTEM INJURY. BASED ON TOX OF CMPDS OF SIMILAR STRUCTURE THIS MATL IS PROBABLY(EFTS OF OVEREXP)

Carcinogenicity:

HEPTACHLOR: IARC MONO ON EVAL OF CARCIN RISK OF CHEMICALS TO MAN, VOL 53, PG 115, 1991: GROUP 2B. ANIMAL LIVER.

OSHA Designation: NO

NTP Designation: NO

IARC Designation: YES

Signs/Symptoms:

HLTH HAZ: HIGHLY HAZARDOUS. EXPOSURE CAN CAUSE LIVER DAMAGE.

Aggravation of Pre-Existing Conditions:

NONE SPECIFIED BY MANUFACTURER.

LD 50 LC 50 Mixture

LD50: (ORAL,RAT) 100 MG/KG

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SECTION 4 : FIRST AID MEASURES

First Aid

AN ANTIDOTE IS SUBSTANCE INTENDED TO COUNTERACT EFT OF POIS. IT SHOULD BE ADMIN ONLY BY MD/TRAINED EMER PERS. MD ADVICE CAN BE OBTAINED FROM POIS CNTRL CNTR. EYE:FLUSH CONTINUOUSLY W/WATER FOR 15-20 MI NS. IF NO BURNS HAVE OCCURRED-USE SOAP & WATER TO CLEANSE SKIN. INHAL: REMOVE PATIENT TO FRESH AIR. ADMIN O*2 IF PATIENT IS HAVING DFCLTY BRTHG. IF PATIENT HAS STOPPED BRTHG ADMIN ARTF RESP.(SUPDAT)

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SECTION 5 : FIRE FIGHTING MEASURES

Flash Point:

N/K

Flash Point Method:

N/P

Upper Flammable or Explosive Limit: N/K

Lower Flammable or Explosive Limit: N/K

Auto Ignition Temperature: N/A

Extinguishing Media:

CARBON DIOXIDE, DRY CHEMICAL POWDER OR SPRAY.

Fire Fighting Instructions:

WEAR NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT(FP N).

Unusual Fire Hazards:

NONE SPECIFIED BY MANUFACTURER.

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SECTION 6 : ACCIDENTAL RELEASE MEASURES

Leak Response:

EVAC AREA. WEAR APPROP OSHA REGULATED EQUIP. VENT AREA. SWEEP UP & PLACE IN APPROP CNTNR. HOLD FOR DISP. WASH CONTAMD SURFACES TO REMOVE ANY RESIDUES.

Other Precautions:

AVOID CONTACT WITH SKIN, EYES AND CLTHG. THIS PRODUCT IS FURNISHED FOR LABORATORY USE ONLY! OUR PRODUCTS MAY NOT BE USED AS DRUGS, COSMETICS, AGRICULTURAL OR PESTICIDAL PRODUCTS, FOOD ADDTIVES OR AS H OUSEHOLD CHEMICALS.

Neutralizing Agent

NONE SPECIFIED BY MANUFACTURER.

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SECTION 7 : HANDLING and STORAGE

Handling:

STORE IN COOL, DRY PLACE. STORE ONLY W/COMPATIBLE CHEMICALS. KEEP TIGHTLY CLOSED. DO NOT BREATHE VAPORS.

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SECTION 8 : EXPOSURE CONTROLS, PERSONAL PROTECTION

Ventilation System:

THIS CHEMICAL SHOULD BE HANDLED ONLY IN HOOD.

Hand Protection Description:

IMPERVIOUS GLOVES(FP N).

Eye/Face Protection:

ANSI APPRVD CHEM WORKERS GOGGS(FP N).

Respiratory Protection:

USE NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN(FP N).

Other Protective:

EMERGENCY EYEWASH & DELUGE SHOWER MEETING ANSI DESIGN CRITERIA(FP N).

Other:

FIRST AID PROC: IF PATIENT IS IN CARDIAC ARREST ADMIN CPR. CONTINUE LIFE SUPPORTING MEASURES UNTIL MED ASSIST HAS ARRIVED. IF INGESTED DO NOT INDUCE VOMITING. ANTIDOTE: GASTRIC LAVAGE (E.G. 2-5% SODIUM BICARBONATE). REMOVE & WASH CONTAMD CLTHG. IF PATIENT IS EXHIBITING SIGNS OF SHOCK - KEEP WARM & QUIT. CONTACT(ING 2)

Work Hygienic Practices

NONE SPECIFIED BY MANUFACTURER.

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SECTION 9 : PHYSICAL AND CHEMICAL PROPERTIES

Physical State/Appearance:

COLORLESS, CRYSTALLINE SOLID W/CAMPHOR LIKE ODOR.

pH:

N/K

Decomposition Temperature:

N/K

Vapor Pressure:

3E-4 @ 25C

Vapor Density:

N/K

Boiling Point:

N/K

Melting Point:

>205F,>96C

Solubility In Water:

INSOL (IMMISCIBLE)

Specific Gravity:

N/K

Evaporation Point:

N/K

Percent Volatile:

N/K

Viscosity:

N/P

Other:

Corrosion Rate: N/K

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SECTION 10 : STABILITY AND REACTIVITY

Chemical Stability:

YES

Conditions to Avoid:

NONE SPECIFIED BY MANUFACTURER.

Incompatibilities with Other Materials:

NONE SPECIFIED BY MANUFACTURER.

Hazardous Polymerization:

NO

Hazardous Decomposition Products:

NONE SPECIFIED BY MANUFACTURER.

Conditions To Avoid Polymerization

NOT RELEVANT.

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SECTION 11 : TOXICOLOGICAL INFORMATION

Toxicological Paragraph:

N/P

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SECTION 12 : ECOLOGICAL INFORMATION

Ecological Paragraph:

N/P

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SECTION 13 : DISPOSAL CONSIDERATIONS

Waste Disposal:

BURN IN CHEMICALS INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
DISPOSE OF IN ACCORDANCE W/LOCAL, STATE & FEDERAL REGULATIONS(FP N).

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SECTION 14 : TRANSPORT INFORMATION

Transportation Information:

N/P

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SECTION 15 : REGULATORY INFORMATION

Applies to all ingredients:

SARA:

N/P

US Federal:

N/P

State:

N/P

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SECTION 16 : ADDITIONAL INFORMATION

MSDS Author:

N/P

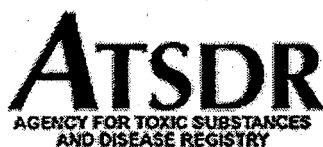
Disclaimer:

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Other Information

N/P

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Polycyclic Aromatic Hydrocarbons (PAHs)

CAS# 130498-29-2**September 1996**

This fact sheet answers the most frequently asked health questions about polycyclic aromatic hydrocarbons (PAHs). For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons (PAHs)?
(Pronounced pol'ee syk'lik ar'o mat'ik hi'dro kar'benz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as

colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to polycyclic aromatic hydrocarbons (PAHs) when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to polycyclic aromatic hydrocarbons (PAHs)?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can polycyclic aromatic hydrocarbons (PAHs) affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons (PAHs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Phone: 1-888-422-8737
FAX: (404)498-0057

External safety and chemistry information (please see our [disclaimer](#)):

Polycyclic Aromatic Hydrocarbons (PAHs)

There is no molecular representation
since this substance is a mixture
of many compounds.

[Vermont SRI MSDS Archive](#)



ATSDR Information Center / ATSDRIC@cdc.gov / 1-888-422-8737

This page last updated on June 11, 2001

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Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are polycyclic aromatic hydrocarbons (PAHs) to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to polycyclic aromatic hydrocarbons (PAHs)?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m³). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m³ averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m³ for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

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Polychlorinated Biphenyls (PCBs)

February 2001

This fact sheet answers the most frequently asked health questions about polychlorinated biphenyls (PCBs). For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls (PCBs)?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily

and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to polychlorinated biphenyls (PCBs) when they enter the environment?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to polychlorinated biphenyls (PCBs)?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How can polychlorinated biphenyls (PCBs) affect my health?

The most commonly observed health effects in people exposed to large

amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are polychlorinated biphenyls (PCBs) to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

How do polychlorinated biphenyls (PCBs) affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported. In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risk of exposure to polychlorinated biphenyls (PCBs)?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories

to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.

- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to polychlorinated biphenyls (PCBs)?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat

illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

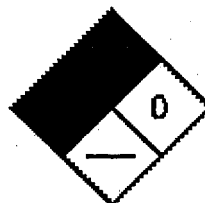
For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Phone: 1-888-422-8737
FAX: (404)498-0057

External safety and chemistry information (please see our [disclaimer](#)):

Octachlorobiphenyl
 $C_{12}H_2Cl_8$

[Stereo Image](#)
[MDL Molfile](#)



NFPA Label Key

Vermont SIRI MSDS Archive

ATSDR Information Center / ATSDRIC@cdc.gov / 1-888-422-8737

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ToxFAQs™ for

Chlorinated Dibenzo-p-dioxins (CDDs)

CAS#

2,3,7,8-TCDD 1746-01-6

February 1999

This fact sheet answers the most frequently asked health questions about CDDs. For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chlorinated dibenzo-p-dioxins (CDDs) (75 chemicals) occurs mainly from eating food that contains the chemicals. One chemical in this group, 2,3,7,8-tetrachlorodibenzo-p-dioxin or 2,3,7,8-TCDD, has been shown to be very toxic in animal studies. It causes effects on the skin and may cause cancer in people. This chemical has been found in at least 91 of 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are CDDs?

CDDs are a family of 75 chemically related compounds commonly known as chlorinated dioxins. One of these compounds is called 2,3,7,8-TCDD. It is one of the most toxic of the CDDs and is the one most studied.

In the pure form, CDDs are crystals or colorless solids.

CDDs enter the environment as mixtures containing a number of individual components. 2,3,7,8-TCDD is odorless and the odors of the other CDDs are not known.

CDDs are not intentionally manufactured by industry except for research purposes. They (mainly 2,3,7,8-TCDD) may be formed during the chlorine bleaching process at pulp and paper mills. CDDs are also formed during chlorination by waste and drinking water treatment plants. They can occur as contaminants in the manufacture of certain organic chemicals. CDDs are released into the air in emissions from municipal solid

waste and industrial incinerators.

What happens to CDDs when they enter the environment?

- When released into the air, some CDDs may be transported long distances, even around the globe.
- When released in waste waters, some CDDs are broken down by sunlight, some evaporate to air, but most attach to soil and settle to the bottom sediment in water.
- CDD concentrations may build up in the food chain, resulting in measurable levels in animals.

How might I be exposed to CDDs?

- Eating food, primarily meat, dairy products, and fish, makes up more than 90% of the intake of CDDs for the general population.
- Breathing low levels in air and drinking low levels in water.
- Skin contact with certain pesticides and herbicides.
- Living near an uncontrolled hazardous waste site containing CDDs or incinerators releasing CDDs.
- Working in industries involved in producing certain pesticides containing CDDs as impurities, working at paper and pulp mills, or operating incinerators.

How can CDDs affect my health?

The most noted health effect in people exposed to large amounts of 2,3,7,8-TCDD is chloracne. Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Other skin effects noted in people exposed to high doses of 2,3,7,8-TCDD include skin rashes, discoloration, and excessive body hair. Changes in blood and urine that may indicate liver damage also are seen in people. Exposure to high concentrations of CDDs may induce long-term alterations in glucose metabolism and subtle changes in hormonal levels.

In certain animal species, 2,3,7,8-TCDD is especially harmful and can cause death a single exposure. Exposure to lower levels can cause a variety of effects in animals, such as weight loss, liver damage, and disruption of the endocrine system. In many species of animals, 2,3,7,8-TCDD weakens the immune system and causes a decrease in the system's ability to fight bacteria and viruses. In other animal studies, exposure to 2,3,7,8-TCDD has caused reproductive damage and birth defects. Some animal species exposed to CDDs during pregnancy had miscarriages and the offspring of animals exposed to 2,3,7,8-TCDD during pregnancy often had severe birth defects including skeletal deformities, kidney defects, and weakened immune responses.

How likely are CDDs to cause cancer?

Several studies suggest that exposure to 2,3,7,8-TCDD increases the risk of several types of cancer in people. Animal studies have also shown an increased risk of cancer from exposure to 2,3,7,8-TCDD.

The World Health Organization (WHO) has determined that 2,3,7,8-TCDD is a human carcinogen.

The Department of Health and Human Services (DHHS) has determined that 2,3,7,8-TCDD may reasonably be anticipated to cause cancer.

How can CDDs affect children?

Very few studies have looked at the effects of CDDs on children. Chloracne has been

seen in children exposed to high levels of CDDs. We don't know if CDDs affect the ability of people to have children or if it causes birth defects, but given the effects observed in animal studies, this cannot be ruled out.

How can families reduce the risk of exposure to CDDs?

- Children should avoid playing in soils near uncontrolled hazardous waste sites.
- Discourage children from eating dirt or putting toys or other objects in their mouths.
- Everyone should wash hands frequently if playing or working near uncontrolled hazardous waste sites.
- For new mothers and young children, restrict eating foods from the proximity of uncontrolled sites with known CDDs.

Is there a medical test to show whether I've been exposed to CDDs?

Tests are available to measure CDD levels in body fat, blood, and breast milk, but tests are not routinely available. Most people have low levels of CDDs in their body fat and blood, and levels considerably above these levels indicate past exposure to above-normal levels of 2,3,7,8-TCDD. Although CDDs stay in body fat for a long time, tests cannot be used to determine when exposure occurred.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.00003 micrograms of 2,3,7,8-TCDD per liter of drinking water (0.00003 µg/L). Discharges, spills, or accidental releases of 1 pound or more of 2,3,7,8-TCDD must be reported to EPA. The Food and Drug Administration (FDA) recommends against eating fish and shellfish with levels of 2,3,7,8-TCDD greater than 50 parts per trillion (50 ppt).

Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Toxicological profile for chlorinated dibenzo-p-dioxins (CDDs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

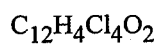
ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

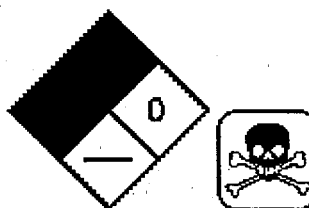
Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Phone: 1-888-422-8737
FAX: (404)498-0057

External safety and chemistry information (please see our disclaimer):

2,3,7,8-Tetrachlorodibenzo-p-dioxin



[Stereo Image](#)
[MDL Molfile](#)



[NFPA Label Key](#)

[Vermont SIRI MSDS Archive](#)

ATSDR Information Center / ATSDRIC@cdc.gov / 1-888-422-8737

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U.S. Department of Health and Human Services

Common Name	CHROMIUM
Manufactured by	ALTA
CAS Number	7440-47-3
Revised	01/06/1992
Source	Dolphin (DOL.116948)
1: Material Identification	
2: Ingredient and Hazards	
3: Physical Data	
4: Fire and Explosion Data	
5 : Reactivity Data	
6 : Health Hazard Data	
7 : Precautions for Safe Handling and Use	
8 : Control Measures	

MATERIAL SAFETY DATA SHEET

**CREATED 7/25/86

**Revised 1/6/92

The ALTA Group
Rte 588 and Fombell Road
RR 2, Box 710
Fombell, PA 16123

Emergency Telephone No 412 452 9043
Telephone No for Information 412 452 1300
FAX 412 452 0818
CHEMTREC 1 800 424 9300

The information below is believed to be accurate and represent the best information available to ALTA. However, the ALTA Group makes no warranty of merchantability or any other warranty, expressed or implied, with such respect to such information and we assume no liability resulting from it's use.

-----Section 1: Material Identification -----

Material Name: Chromium
Description: Metallic element of atomic number 24
Group VI B of the Periodic Table.
Formula: Cr
Other Designations: CAS: 7440-47-3
NIOSH: GB 4200000

-----Section 3: Physical Data -----

Boiling Point: 2672 DEG. C
Vapor Pressure (mm Hg): 1 mm at 1616 DEG. C
Melting Point: 1900 DEG. C
Vapor Density: Nil
Specific Gravity: 7.1
Evaporation Rate: N/A
Solubility in Water: Insoluble
Atomic Weight: 52
Appearance: Gray amorphous powder/odorless

-----Section 4: Fire and Explosion Data -----

Flash.Point and Method: N/A
Flammability Limits in Air: N/A
Lower: N/A
Upper: N/A
Autoignition . Temp: 1890 DEG. C for pieces; if powdered, may be as low as 400 DEG. C

Extinguishing Media:
Dry chemical, or sand; Class "D" extinguishing media.

Special Fire Fighting Procedures:
Fire fighters should use self-contained breathing apparatus. Avoid inhaling smoke, avoid all contact with dust from ash.

Unusual Fire and Explosion Hazards:
Powder will ignite in air when exposed to heat or ignition sources.
Index of explosivity of 0.1 Ignites and is potentially explosive in the atmosphere of CO2. Chromium oxides in smoke and ash becomes flammable.

-----Section 6 : Health Hazard Data -----

Routes of Entry
Inhalation: yes (dust or fumes)
Skin: no
Ingestion: yes

Health Hazards
Acute and Chronic:
For large pieces, there is no credible hazards. See Chromium Powder

MSDS.

*Inhalation-Chromium metal is relatively non-toxic. Inhalation of powder is dependent on its particle size. Chromium metals and insoluble salts are said to be involved in histological fibrosis of the lungs. When metal is heated to a higher temperature, fumes produced may be damaging to the lungs when inhaled (possible pneumoconiosis).

*Dermal and Eye contact-Dust or powders may cause eye or skin irritations.

*Other-Chromium metal can react with other chemicals to form hexavalent chromium compounds which are carcinogenic (OSHA) and corrosive in tissues resulting in ulcers and dermatitis on prolonged contact.

**The International Agency for Research on Cancer has determined a "casual" association between occupational exposure to chromium and certain chromium compounds and cancer in humans.

This determination was based on evidence where exposures were essential to hexavalent chromium compounds.

Carcinogenicity:

Known carcinogen

Signs and Symptoms of Exposure:

none

Medical Conditions Generally Aggravated by Exposure:

none

Emergency and First Aid Procedures:

For large pieces, there is no credible hazards. See Chromium Powder MSDS.



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View Section:

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4-METHYLPHENOL, O-872

SECTION 1 : CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MSDS Name: 4-METHYLPHENOL, O-872

Manufacturer Name: CHEM SERVICE INC

Address:

Box: 3108

City: WEST CHESTER

State: PA

Zip: 19381

Country: US

Business Phone: 215-692-3026

For information in North America, call: 215-692-3026

Health Phone: 215-692-3026

Manufacturer MSDS Creation Date:

09/01/1988

[To Top of page](#)**SECTION 2 : COMPOSITION, INFORMATION ON INGREDIENTS**

Chemical Name	CAS#	Percent	
P-CRESOL; (4-METHYLPHENOL)	106-44-5	N/K	

RTECS:

GO6475000

OSHA PEL TWA: 5 PPM, S

ACGIH TLV TWA: 5 PPM, S

ACGIH STEL/Ceiling: N/P

Comments:

Other REC Limits: N/K ; EPA Rpt Qty: 1000 LBS ; DOT Rpt Qty: 1000 LBS ; Ozone Depleting Chemical: N ;

[To Top of page](#)**SECTION 3 : HAZARDS IDENTIFICATION**

P-CRESOL; (4-METHYLPHENOL):

Route of Exposure:

Inhalation: YES Skin: YES Ingestion: YES

Potential Health Effects:

ALL CHEMICALS SHOULD BE CONSIDERED HAZ - AVOID DIRECT PHYSICAL CONTACT!
CAN BE FATAL IF ABSORBED THROUGH THE SKIN! CAN BE FATAL IF INHALED! MAY BE
FATAL IF SWALLOWED! CAN CAUSE EYE IRRITATION. CAN CAUSE SKIN IRRITATION.
CAN BE HARMFUL IF ABSORBED THROUGH THE SKIN. CAN BE HARMFUL IF INHALED.
CAN BE (EFTS OF OVEREXP)

Carcinogenicity:

NOT RELEVANT

OSHA Designation: NO

NTP Designation: NO

IARC Designation: NO

Signs/Symptoms:

HLTH HAZ: HARMFUL IF SWALLOWED. CAN BE IRRITATING TO MUCOUS MEMBRANES.
PROLONGED EXPOSURE MAY CAUSE NAUSEA/HEADACHE/DIZZINESS AND/OR EYE
DAMAGE. CAN CAUSE KIDNEY INJURY.

Aggravation of Pre-Existing Conditions:

NONE SPECIFIED BY MANUFACTURER.

LD 50 LC 50 Mixture

LD50: (RAT) 207 MG/KG

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SECTION 4 : FIRST AID MEASURES

First Aid

ANTIDOTE IS SUBSTANCE INTENDED TO COUNTERACT EFT
OF POISON. IT SHOULD BE ADMIN ONLY BY MD/TRAINED
EMER PERS. MED ADVICE CAN BE OBTAINED FROM POIS
CTL CTR. EYES: FLUSH CONTINUOUSLY W/WATER FOR AT
LEAST 15-20 MIN. SKIN: FLUSH W/WATER FOR 15-20 MIN.
IF NO BURNS HAVE OCCURRED-USE SOAP & WATER TO
CLEANSE SKIN. INHAL: REMOVE TO FRESH AIR. ADMIN
OXYGEN IF HAVING DIFFICULTY BRTHG. IF BRTHG HAS
STOPPED (SUPDAT)

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SECTION 5 : FIRE FIGHTING MEASURES

Flash Point:

187F,86C

Flash Point Method:

N/P

Upper Flammable or Explosive Limit: N/K

Lower Flammable or Explosive Limit: N/K

Auto Ignition Temperature: N/A

Extinguishing Media:

CARBON DIOXIDE, DRY CHEMICAL POWDER OR WATER SPRAY.

Fire Fighting Instructions:

USE NIOSH/MSHA APPROVED SCBA AND FULL PROTECTIVE EQUIPMENT (FP N).

Unusual Fire Hazards:

THIS IS A COMBUSTIBLE COMPOUND.

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SECTION 6 : ACCIDENTAL RELEASE MEASURES

Leak Response:

EVACUATE AREA. WEAR APPROPRIATE OSHA-REGULATED EQUIPMENT. VENTILATE AREA. SWEEP UP AND PLACE IN AN APPROPRIATE CONTAINER. HOLD FOR DISPOSAL. WASH CONTAMINATED SURFACES TO REMOVE ANY RESIDUES.

Other Precautions:

PERSONS NOT SPECIFICALLY & PROPERLY TRAINED SHOULD NOT HANDLE THIS CHEM OR ITS CNTNR. THIS PROD IS FURNISHED FOR LAB USE ONLY! PRODS MAY NOT BE USED AS DRUGS, COSMETICS, AGRICULTURAL/PESTICIDAL PRODS, FOOD ADDITIVES OR AS HOUSEHOLD CHEMS.

Neutralizing Agent

NONE SPECIFIED BY MANUFACTURER.

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SECTION 7 : HANDLING and STORAGE

Handling:

AVOID CONTACT WITH SKIN, EYES AND CLOTHING. KEEP TIGHTLY CLOSED AND STORE IN A COOL, DRY PLACE. STORE ONLY WITH COMPATIBLE CHEMICALS.

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SECTION 8 : EXPOSURE CONTROLS, PERSONAL PROTECTION

Ventilation System:

THIS CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD.

Hand Protection Description:

IMPERVIOUS GLOVES (FP N).

Eye/Face Protection:

ANSI APPRVD CHEM WORKERS GOGGLES (FP N)

Respiratory Protection:

USE NIOSH/MSHA APPROVED RESPIRATOR.

Other Protective:

ANSI APPROVED EYE WASH & DELUGE SHOWER (FP N). USE APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT.

Other:

FIRST AID PROC: ADMIN ARTF RESP. IF IN CARD ARREST ADMIN CPR. CONTINUE LIFE SUPPORTING MEASURES UNTIL MED ASSISTANCE HAS ARRIVED.

Work Hygienic Practices

CONTACT LENSES SHOULD NOT BE WORN IN THE LABORATORY.

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SECTION 9 : PHYSICAL AND CHEMICAL PROPERTIES

Physical State/Appearance:

COLORLESS CRYSTALLINE SOLID; PHENOL LIKE ODOR.

pH:

N/K

Decomposition Temperature:

N/K

Vapor Pressure:

0.10 @ 20C

Vapor Density:

N/K

Boiling Point:

396F, 202C

Melting Point:

95.9F, 35.5C

Solubility In Water:

SOLUBLE

Specific Gravity:

1.034

Evaporation Point:

N/K

Percent Volatile:

N/K

Viscosity:

N/P

Other:

Corrosion Rate: N/K

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SECTION 10 : STABILITY AND REACTIVITY

Chemical Stability:

YES

Conditions to Avoid:

SENSITIVE TO LIGHT - DARK COLOR DOES NOT AFFECT PURITY. COMBUSTIBLE.

Incompatibilities with Other Materials:

INCOMPATIBLE WITH STRONG BASES. INCOMPATIBLE WITH STRONG OXIDIZING AGENTS.

Hazardous Polymerization:

NO

Hazardous Decomposition Products:

DECOMPOSITION LIBERATES TOXIC FUMES. DECOMPOSITION PRODUCTS ARE CORROSIVE.

Conditions To Avoid Polymerization

NOT RELEVANT

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SECTION 11 : TOXICOLOGICAL INFORMATION

Toxicological Paragraph:

N/P

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SECTION 12 : ECOLOGICAL INFORMATION

Ecological Paragraph:

N/P

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SECTION 13 : DISPOSAL CONSIDERATIONS

Waste Disposal:

DISPOSAL MUST BE IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS (FP N). BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

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SECTION 14 : TRANSPORT INFORMATION

Transportation Information:

N/P

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SECTION 15 : REGULATORY INFORMATION

P-CRESOL; (4-METHYLPHENOL):

SARA:

N/P

US Federal:

N/P

State:

N/P

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SECTION 16 : ADDITIONAL INFORMATION

MSDS Author:

N/P

Disclaimer:

Please note that although the information, opinions and recommendations contained in these Material Safety Data Sheets are compiled from sources believed to be reliable, we accept no responsibility for the accuracy, sufficiency, or reliability or for any loss or injury resulting from the use of the information. Newly discovered hazards are frequent and this information may not be completely up to date.

Other Information

N/P

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Material Safety Data Sheet

Revision Issued: 3/23/2000

Supersedes: 4/13/98

First Issued: 4/13/98

Section I - Chemical Product And Company Identification

Product Name: Sulfuric Acid 20-74%

CAS Number: 7664-93-9

HBCC MSDS No. CS18910

**HILL BROTHERS** *Chemical Co.*1675 NORTHMAIN STREET • ORANGE, CALIFORNIA 92867-3499
(714) 998-8800 • FAX: (714) 998-6310
<http://hillbrothers.com>1675 No. Main Street, Orange, California 92867
Telephone No: 714-998-8800 | Chemtrec: 800-424-9300

Section II - Composition/Information On Ingredients

			Exposure Limits (TWAs) in Air		
Chemical Name	CAS Number	%	ACGIH TLV	OSHA PEL	STEL
Sulfuric Acid (H ₂ SO ₄)	7664-93-9	20-74	1 mg/m ³	1 mg/m ³	3 mg/m ³

Section III - Hazard Identification

Routes of Exposure: Sulfuric acid can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

Points of Attack: Sulfuric acid attacks the respiratory system, eyes, skin, teeth, and lungs.

Summary of Acute Health Hazards: Concentrated sulfuric acid will effectively remove the elements of water from many organic materials with which it comes in contact. It is even more rapidly injurious to mucous membranes and exceedingly dangerous to the eyes.

Ingestion: Causes serious burns of the mouth or perforation of the esophagus or stomach. May be fatal if swallowed.

Inhalation: Corrosive and highly toxic. May be harmful or fatal if inhaled. May cause severe irritation and burns of the nose, throat and respiratory tract.

Skin: Splashes on the skin will cause severe skin burns. Burning and charring of the skin are a result of the great affinity for, and strong exothermic reaction with, water. Direct contact can be severely irritating to the skin and may result in redness, swelling, burns and severe skin damage.

Eyes: Direct contact with the liquid or exposure to vapors or mists may cause stinging, tearing, redness, swelling, corneal damage and irreversible eye damage. Splashes in the eyes will cause severe burns. Contact lenses should not be worn when working with this chemical.

Effects of Overexposure: May cause severe irritation and burns of the mouth,, nose, throat, respiratory and digestive tract, coughing, nausea, vomiting, abdominal pain, chest pain, pneumonitis (inflammation of the fluid in the lungs), pulmonary edema (accumulation of the fluid in the lungs), and perforation of the stomach. Overexposure to acid mists has been reported to cause erosion to tooth enamel.

Medical Conditions Generally Aggravated by Exposure: Persons with pre-existing skin disorders and/or respiratory disorders (e.g. Asthma-like conditions) may be more susceptible to the effects of this material, and may be aggravated by exposure to this material.

Note to Physicians: Sulfuric acid is reported to cause pulmonary function impairment. Periodic surveillance is indicated. Sulfuric acid may cause acute lung damage.

Surveillance of the lungs is indicated. Ingestion may cause gastroesophageal perforation. Perforation may occur within 72 hours, but along with abscess formation, can occur weeks later. Long term complications may include esophageal, gastric or pyloric strictures or stenosis.

Section IV - First Aid Measures

Ingestion: If liquid sulfuric acid or solutions containing sulfuric acid have been swallowed and the person is conscious, give him one glass of water (1/2 glass of water to children under 5), immediately to dilute the sulfuric acid. Do NOT induce vomiting. Do not attempt to make the exposed person vomit. Do not leave victim unattended. GET MEDICAL ATTENTION IMMEDIATELY.

Inhalation: If a person breathes in large amounts of sulfuric acid, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. If breathing is difficult, give oxygen. Keep the affected person warm and at rest. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

Skin: If liquid sulfuric acid or solutions containing sulfuric acid get on the skin, immediately flush the contaminated skin with water for at least 15 minutes. If skin surface is damaged, apply a clean dressing. If liquid sulfuric acid or solutions containing sulfuric acid penetrate through the clothing, immediately remove the clothing, shoes and constrictive jewelry under a safety shower and continue to wash the skin for at least 15 minutes. GET MEDICAL ATTENTION IMMEDIATELY.

Eyes: If liquid sulfuric acid or solutions containing sulfuric acid get into the eyes, flush eyes immediately with a directed stream of water for at least 30 minutes while forcibly holding eyelids apart to ensure complete irrigation of all eye and lid tissue. GET MEDICAL ATTENTION IMMEDIATELY. Contact lenses should not be worn when working with this chemical.

Section V - Fire Fighting Measures

Flash Point: Non-flammable

Autoignition Temperature: N/A

Lower Explosive Limit: N/A

Upper Explosive Limit: N/A

Unusual Fire and Explosion Hazards: Not flammable but highly reactive and capable of igniting finely divided combustible materials on contact. Reacts violently with water and organic materials with evolution of heat. If involved in fire, may release hazardous oxides of sulfur. Vapors are heavier than air and may accumulate in low areas. Containers exposed to extreme heat may rupture due to pressure buildup. Contact with common metals may generate hydrogen, which can form flammable mixture with air.

Extinguishing Media: Fires involving small amount of combustibles may be smothered with suitable dry chemical, soda ash, lime, sand or CO₂. Use water on combustibles burning in vicinity of this material but use care as water applied directly to this acid results in evolution of heat and causes splattering.

Special Firefighting Procedures: Causes severe, deep burns to tissue; very corrosive effect. Sulfuric Acid is extremely slippery. Emergency responders in the danger area should wear bunker gear and self contained breathing apparatus for fires beyond the incipient stage (29CFR 1910.156). In addition, wear other appropriate protective equipment as conditions warrant (see Section 8). Water reactive. Contact with water may generate heat. Isolate damage area, keep unauthorized personnel out. If tank, railcar, or tank truck is involved in a fire, isolate for 1/2 mile in all directions. Consider initial evacuation for 1/2 mile in all directions. Stop spill/release if it can be done with minimal risk. Move undamaged containers from danger area if it can be done with minimal risk. Fires involving small amounts of combustibles may be smothered with suitable dry chemicals. Use water on combustibles burning but avoid using water directly on acid as it results in evolution of heat and causes splattering.

Section VI - Accidental Release Measures

If sulfuric acid is spilled or leaked, ventilate area. Collect spilled or leaked material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill. Sulfuric acid should be absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized. Add slowly to solution of soda ash and slaked lime with stirring. Use Caution around spill area, Sulfuric Acid is extremely slippery. Stay upwind and away from spill release.

Section VII - Handling and Storage

Protect against physical damage and water. Keep containers closed. Sulfuric Acid is extremely slippery. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276. To prevent ignition of hydrogen gas generated in metal containers (from metal contact) smoking, open flames and sparks must not be permitted in storage areas. This product has a great affinity for water, abstracting it from the air and also from many organic substances; hence it will char wood, etc.. When diluting, the acid should be added to the diluent. Separate from carbides, chlorates, fulminates, nitrates, picrates, powdered metals, and combustible materials. Keep away from strong oxidizing agents including oxygen and chlorine.

Other Precautions: Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

Section VIII - Exposure Controls/Personal Protection

Respiratory Protection: Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration or by the National Institute for Occupational Safety and Health, such as a powered air purifying respirator.

Ventilation: General mechanical ventilation may be sufficient to keep sulfuric acid vapor concentrations within specified time-weighted TLV range. If general ventilation proves inadequate to maintain safe vapor concentrations, supplemental local exhaust may be required.

Protective Clothing: Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid sulfuric acid or solutions containing more than 1% sulfuric acid by weight.

Eye Protection: Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid sulfuric acid or solutions containing sulfuric acid contacting the eyes. Contact lenses should not be worn when working with this chemical.

Other Protective Clothing or Equipment: Rubber apron, rubber boots, eyewash stations and safety showers must be available in the immediate work area for emergency use.

Work/Hygienic Practices: Avoid contact with the skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands before eating, drinking, or using restroom.

Section IX - Physical and Chemical Properties

Physical State: Liquid

pH: 1.0

Melting Point/Range: 3° C; 37°F

Boiling Point/Range: 260° F; 315° C

Appearance/Color/Odor: Colorless to dark brown; odorless unless hot, then choking

Solubility in Water: 100%

Vapor Pressure(mmHg): 1 @ 145.8°F

% Acid in Solution	20	30	35	36	40	50	72
Specific Gravity	1.09-1.10	1.2-1.3	1.3	1.3	1.3	1.4	1.6-1.7
Weight/Gallon in	9.1-9.2	12.0	15.2	15.2	10.79	10.79	N/A

Molecular Weight: 98

Vapor Density(Air=1): 3.4

% Volatiles: Negligible

How to detect this compound : Sampling and analyses may be performed by collection of sulfuric acid on a cellulose membrane filter, followed by extraction with distilled water and isopropyl alcohol, treatment with perchloric acid, and titration with barium perchlorate. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure sulfuric acid may be used.

Section X - Stability and Reactivity

Stability: Stable

Hazardous Polymerization: Will not occur

Conditions to Avoid: Temperatures above 150°F

Materials to Avoid: Contact of acid with organic materials (such as chlorates, carbides, fulminates, and picrates), alkaline materials and water may cause fires and explosions. Contact of acid with metals may form toxic sulfur dioxide fumes and flammable hydrogen gas. Contact with hypochlorites (e.g., chlorine bleach), sulfides, or cyanides will produce toxic gases.

Hazardous Decomposition Products: Toxic gases and vapors (such as sulfuric acid fume, sulfur dioxide, and carbon monoxide) may be released when sulfuric acid

decomposes. Decomposes to water and sulfur trioxide above 644°F.

Section XI - Toxicological Information

Sulfuric acid mist severely irritates the eyes, respiratory tract, and skin. Concentrated sulfuric acid destroys tissue due to its severe dehydrating action, whereas the dilute form acts as a mild irritant due to acid properties. The LC50 of mist of 1-micron particle size for an 8 hour exposure was 50 mg/m³ for adult guinea pigs and 18 mg/m³ for young animals. Continuous exposure of guinea pigs to 2 mg/m³ for 5 days caused pulmonary edema and thickening of the alveolar walls; exposure of guinea pigs to 2 mg/m³ for 1 hour caused an increase in pulmonary airway resistance from reflex bronchoconstriction. A worker sprayed in the face with liquid fuming sulfuric acid suffered skin burns of the face and body, as well as pulmonary edema from inhalation. Sequelae were pulmonary fibrosis, residual bronchitis, and pulmonary emphysema; in addition, necrosis of the skin resulted in marked scarring. In human subjects, concentrations of about 5 mg/m³ were objectionable, usually causing cough, an increase in respiratory rate, and impairment of ventilatory capacity. Workers exposed to concentrations of 12.6 to 35 mg/m³ had a markedly higher incidence of erosion and discoloration of teeth than was noted in unexposed individuals. Splashed in the eye, the concentrated acid causes extremely severe damage, often leading to blindness, whereas dilute acid produces more transient effects from which recovery may be complete. Repeated exposure of workers to the mist causes chronic conjunctivitis, tracheobronchitis, stomatitis, and dermatitis, as well as dental erosion. While ingestion of the liquid is unlikely in ordinary industrial use, the highly corrosive nature of the substance may be expected to produce serious mucous membrane burns of the mouth and esophagus.

Section XII - Ecological Information

N/A

Section XIII - Disposal Considerations

Sulfuric acid may be placed in sealed containers or absorbed in vermiculite, dry sand, earth, or a similar material and disposed of in a secured sanitary landfill. It may also be diluted and neutralized. Check with your Federal, State, and Local authorities as neutralized sulfuric acid may be allowed to be flushed down the drain. Empty containers must be handled with care due to material residue.

Section XIV - Transport Information

DOT Proper Shipping Name: RQ Sulfuric Acid

% Acid in Solution	20-51	52-74
DOT Hazard Class/ I.D.	8, UN2796, II	8, UN1830, II

Section XV - Regulatory Information

Reportable Quantity: 1,000 Pounds (454 Kilograms) (92.68 Gal.)

NFPA Rating: Health - 3; Fire - 0; Reactivity - 2

0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

Carcinogenicity Lists: Yes NTP: No IARC Monograph: No OSHA Regulated: Yes

Section 313 Supplier Notification: This product contains the following toxic chemical(s) subject to the reporting requirements of SARA TITLE III Section 313 of the Emergency Planning and Community Right-To Know Act of 1986 and of 40 CFR 372:

CAS #	Chemical Name	% By Weight
7664-93-9	Sulfuric Acid	20-74

Section XVI - Other Information

Synonyms/Common Names: H₂SO₄; Oil of Vitriol; Spirit of Sulfur; Hydrogen Sulfate; Oleum

Chemical Family/Type: Inorganic Acid

Sections changed since last revision: I, II, IX, XIV, XV

IMPORTANT! Read this MSDS before use or disposal of this product. Pass along the information to employees and any other persons who could be exposed to the product to be sure that they are aware of the information before use or other exposure. This MSDS has been prepared according to the OSHA Hazard Communication Standard [29 CFR 1910.1200]. The MSDS information is based on sources believed to be reliable. However, since data, safety standards, and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, **Hill Brothers Chemical Company** makes no warranty, either expressed or implied, with respect to the completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. Also, additional information may be necessary or helpful for specific conditions and circumstances of use. It is the user's responsibility to determine the suitability of this product and to evaluate risks prior to use, and then to exercise appropriate precautions for protection of employees and others.

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Material Safety Data Sheet

Revision Issued: 8/26/99

Supersedes: 7/29/92

First Issued: 5/27/87

Section I - Chemical Product And Company Identification

Product Name: Methanol

CAS Number: 67-56-1

HBCC MSDS No. CM07000

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Section II - Composition/Information On Ingredients

			Exposure Limits (TWAs) in Air		
Chemical Name	CAS Number	%	ACGIH TLV	OSHA PEL	STEL
Methanol	67-56-1	100	200 ppm	200 ppm	250 ppm

Section III - Hazard Identification

Routes of Exposure: Methanol may affect the body either through ingestion, inhalation, or contact with the eyes and/or skin.**Summary of Acute Health Hazards****Ingestion:** Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.**Inhalation:** A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.**Skin:** Prolonged contact with the skin may cause reddening and defatting of the skin and may aggravate an existing dermatitis.**Eyes:** May cause mild redness and swelling of the conjunctiva, with transient superficial injury of the cornea.**Summary of Chronic Health Hazards:** N/A**Signs and Symptoms of Exposure:** : Methanol may affect the body either through ingestion, inhalation, or contact with the eyes and/or skin.**Effects of Overexposure:** : Long-term repeated exposure to high vapor concentrations (greater than 1000 ppm may produce impairment of vision.**Medical Conditions Generally Aggravated by Exposure:** Persons with pre-existing skin disorders, impaired liver function, impaired renal function, or pre-existing eye diseases might have increased health risks working with methanol.**Note to Physicians:** : Treatment should include the following: hemodialysis; the intravenous administration of ethanol (10 ml per hour) to interfere with the metabolism of methanol; and the administration of sodium bicarbonate to correct acidosis.

Section IV - First Aid Measures

Ingestion: Give two glasses of water and induce vomiting. GET MEDICAL ATTENTION IMMEDIATELY. Do not make an unconscious person vomit.

Inhalation: Move the exposed person to fresh air at once. If breathing is difficult, administer oxygen; if breathing has stopped, perform artificial respiration. GET MEDICAL ATTENTION IMMEDIATELY.

Skin: Promptly flush the contaminated skin with water. If skin irritation persists, GET MEDICAL ATTENTION.

Eyes: Wash eyes immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. GET MEDICAL ATTENTION IMMEDIATELY. Contact lenses should not be worn when working with this chemical.

Section V - Fire Fighting Measures

Flash Point: 52°F, T.C.C.; 58°F, T.O.C.

Autoignition Temperature: 725°F

Lower Explosive Limit: 6.0% by volume in air

Upper Explosive Limit: 36.0% by volume in air

Unusual Fire and Explosion Hazards: Vapors formed from this liquid, are heavier than air, and may be moved by air currents. Flashback of flame along the vapor trail to the handling site may occur.

Extinguishing Media: Dry chemical, alcohol foam, or carbon dioxide.

Special Firefighting Procedures: Use water spray to cool fire-exposed containers and structures. Approach methanol fire with caution; methanol burns with an almost invisible flame in daylight. Use self-contained breathing apparatus and protective clothing.

Section VI - Accidental Release Measures

Steps To Be Taken In Case Material Is Released Or Spilled: [Spills may need to be reported to the National Response Center (800/424-8802) CERCLA Reportable Quantity (RQ) is 5000 pounds]. Eliminate all ignition sources. Handling equipment must be grounded to prevent sparking. For large spills, evacuate the hazard area of unprotected personnel. Wear appropriate respirator and protective clothing. Shut off source of leak only if safe to do so. Dike and contain. If vapor cloud forms, water fog may be used to suppress; contain run-off. Remove with vacuum trucks or pump to storage/salvage vessels. Soak up residue with an absorbent such as clay, sand or other suitable material, and place in non-leaking containers for proper disposal. Flush area with water to remove trace residue; dispose of flush solutions as above. For small spills, take up with an absorbent material and place in non-leaking containers; seal tightly for proper disposal.

Section VII - Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be 'No Smoking' areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

Other Precautions: The reaction of methanol with nitric acid is considered hazardous not only because it is exothermic, but also because it produces methyl nitrate. Methyl nitrate reportedly can explode violently if shocked mechanically or heated. Disposal: At low concentrations in water, methanol is readily biodegradable in biological wastewater treatment plant.

Section VIII - Exposure Controls/Personal Protection

Respiratory Protection: Use MSHA/NIOSH approved self-contained breathing apparatus in high vapor concentrations.

Respirator Selection

2000 ppm: SA/SCBA

10,000 ppm: SAF/SCBAF

25,000 ppm: SAF: PD,PP,CF

Escape: SCBA

Ventilation: This product should be confined within closed equipment, in which case general (mechanical) room ventilation should be suitable. Special, local ventilation is needed at points where vapors are expected to be vented to the workplace air.

Protective Clothing: Avoid prolonged or repeated contact with the skin. Wear chemical-resistant clothing, including boots, gloves, lab coat apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection: Avoid contact with the eyes. Wear chemical goggles if there is the likelihood of contact with the eyes. Maintain eye wash fountain and quick-drench facilities in work area.

Other Protective Clothing or Equipment: An eye bath, safety shower, chemical apron and boots should be available.

Work/Hygienic Practices: All employees who handle methanol should wash their hands before eating, smoking, or using the toilet facilities.

Section IX - Physical and Chemical Properties

Physical State: Liquid

pH: N/A

Melting Point/Range: -98°C (-144°F)

Boiling Point/Range: 64°C (148°F)

Appearance/Color/Odor: Watery, colorless liquid with a pungent odor

Solubility in Water: 100%

Vapor Pressure(mmHg): 127 @ 25°C (77°F)

Specific Gravity(Water=1): 0.792 @ 20°C (68°F)

Molecular Weight: 32.04

Vapor Density(Air=1): 1.11

% Volatiles: 100%

How to detect this compound : Adsorption on silica, workup with water, analysis by gas chromatography.

Section X - Stability and Reactivity

Stability: Stable

Hazardous Polymerization: Will Not Occur

Conditions to Avoid: Avoid heat, sparks and flame - all ignition sources.

Materials to Avoid: Alkali metals, concentrated nitric and sulfuric acids, aldehydes, acyl chlorides, and strong oxidizers. The reaction of methanol with nitric acid is considered hazardous not only because it is exothermic, but also because it produces methyl nitrate. Methyl nitrate reportedly can explode violently if shocked mechanically or heated.

Hazardous Decomposition Products: Burning can produce carbon monoxide and/or carbon dioxide, and formaldehyde.

Section XI - Toxicological Information

Toxicity Data

Grade 1; LD₅₀=5 to 15 g/kg (rat),

IDLH Value: 25,000 ppm,

Aquatic: 250 ppm/11 hr/goldfish/died/fresh water,

Biological Oxygen Demand (BOD): 0.6 to 1.12 lb/lb in 5 days

Section XII - Ecological Information

N/A

Section XIII - Disposal Considerations

This product when spilled or disposed is a hazardous waste (RCRA-40 CFR 261). Preferred method is incineration or biological treatment in a federal/state approved

facility. Consult Federal, State, or Local Authorities for proper disposal procedures.

Section XIV - Transport Information

DOT Proper Shipping Name: Methanol or Methyl Alcohol

DOT Hazard Class/ I.D. No.: 3, UN1230, II

Section XV - Regulatory Information

Reportable Quantity: 5,000 Pounds (2270 Kilograms)

NFPA Rating: Health - 1; Fire - 3; Reactivity - 0

0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

Carcinogenicity Lists: NTP: No IARC Monograph: No OSHA Regulated: No

Section 313 Supplier Notification: This product contains the following toxic chemical(s) subject to the reporting requirements of SARA TITLE III Section 313 of the Emergency Planning and Community Right-To Know Act of 1986 and of 40 CFR 372:

<u>CAS #</u>	<u>Chemical Name</u>	<u>% By Weight</u>
67-56-1	Methanol	100

Section XVI - Other Information

Synonyms/Common Names: Methyl Alcohol, Carbinol, Wood Alcohol, Wood Spirit

Chemical Family/Type: Alcohols

IMPORTANT! Read this MSDS before use or disposal of this product. Pass along the information to employees and any other persons who could be exposed to the product to be sure that they are aware of the information before use or other exposure. This MSDS has been prepared according to the OSHA Hazard Communication Standard [29 CFR 1910.1200]. The MSDS information is based on sources believed to be reliable. However, since data, safety standards, and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, **Hill Brothers Chemical Company** makes no warranty, either expressed or implied, with respect to the completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. Also, additional information may be necessary or helpful for specific conditions and circumstances of use. It is the user's responsibility to determine the suitability of this product and to evaluate risks prior to use, and then to exercise appropriate precautions for protection of employees and others.

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Material Safety Data Sheet

Revision Issued: 9/25/2001

Supersedes: 4/13/2000

First Issued: 12/01/85

Section I - Chemical Product And Company Identification

Product Name: Nitric Acid

Synonyms/Common Names: Aqua Fortis; Hydrogen Nitrate; HNO₃

CAS Number: 7697-37-2

HBCC MSDS No. CN03300

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Section II - Composition/Information On Ingredients

			Exposure Limits (TWAs) in Air		
Chemical Name	CAS Number	%	ACGIH TLV	OSHA PEL	STEL
Nitric Acid	7697-37-2	30-71	2 ppm	2 ppm	4 ppm

Section III - Hazard Identification

Routes of Exposure: Nitric acid can affect the body if it is inhaled or swallowed, or if it comes in contact with the eyes or skin.**Summary of Acute Health Hazards****Ingestion:** Can cause irritation and severe corrosive burns to mouth, throat, and stomach, and may be fatal if swallowed.**Inhalation:** Gases or acid mist can cause severe irritation or corrosive burns to the upper respiratory system, including nose, mouth, and throat. Lung irritation, nitrogen oxide poisoning, and pulmonary edema can also occur. May cause severe breathing difficulties which may be delayed in onset.**Skin:** Can cause severe corrosive burns or irritation. May stain the skin bright yellow.**Eyes:** Can cause irritation, corneal burns, conjunctivitis, and may cause blindness. Contact lenses should not be worn when working with this material.**Summary of Chronic Health Hazards:** N/A**Effects of Overexposure:** Possible acute pulmonary edema, chronic obstructive pulmonary disease, or chronic bronchitis from inhalation. The vapor and mist may erode the exposed teeth. On the skin or through ingestion, the liquid may cause pain and severe and penetrating burns. In contact with the eyes, the liquid produces severe burns which may lead to visual impairment or blindness.**Medical Conditions Generally Aggravated by Exposure:** Skin disorders and respiratory (asthma-like) disorders.**Note to Physicians:** Nitric Acid vapors contain nitrogen oxides. Acute overexposure by inhalation can result in delayed pulmonary edema. Observe affected patients for delayed effects up to 48 hours after exposure. Screen patients with chest x-ray, arterial blood gas, methemoglobinemia level, and pulmonary function tests. Bronchiolitis obliterans may develop weeks after exposure.

Section IV - First Aid Measures

Ingestion: DO NOT INDUCE VOMITING. Drink large amounts of water to dilute acid. GET PROMPT MEDICAL ATTENTION.

Inhalation: If inhaled, will cause difficult breathing or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. GET PROMPT MEDICAL ATTENTION.

Skin: Promptly flush with plenty of soap and water for at least 15 minutes. Remove contaminated clothing. Wash clothing before reuse. GET PROMPT MEDICAL ATTENTION.

Eyes: Wash eyes immediately with large amounts of water, for at least 30 minutes, lifting the lower and upper lids. Contact lenses should not be worn when working with this material. Do not allow victim to rub or keep eyes closed. GET PROMPT MEDICAL ATTENTION.

Section V - Fire Fighting Measures

Flash Point: Not Flammable

Autoignition Temperature: N/A

Lower Explosive Limit: N/A

Upper Explosive Limit: N/A

Unusual Fire and Explosion Hazards: Will accelerate the burning of combustible materials and can cause ignition by contact with combustible materials. Contact with common materials may generate hydrogen gas, which can form flammable mixtures with air.

Extinguishing Media: Use water in flooding quantities as fog on adjacent fires.

Special Firefighting Procedures: Water spray may be useful in minimizing or dispersing vapors and cooling equipment exposed to heat and flame. In danger area, wear bunker gear and self-contained breathing apparatus for fires beyond the incipient range (29CFR 1910.156)

Section VI - Accidental Release Measures

Spills may need to be reported to the National Response Center (800/424-8802) DOT Reportable Quantity (RQ) is 1000 pounds Adequate ventilation is required to eliminate any nitrogen oxides released and, if soda ash or limestone is used, CO₂. Stay upwind and away from spill. Keep all ignition sources and hot metal surfaces away from spill/release. Keep material out of water sources and sewers. Build dikes using inert material (i.e. dry sand or earth) to contain flow as necessary. Dilute spills or leaks with plenty of water. Neutralize residue with sodium bicarbonate, then place into a chemical waste container. A vapor suppressing foam may be used to reduce vapors.

Section VII - Handling and Storage

Avoid inhalation of vapors or mists and all bodily contact. Keep away from incompatible substances. Store in a cool, well-ventilated, properly drained area out of the sun. Avoid storage on wood floors or near wooden walls, etc. Diking of storage tanks if recommended. Protect from physical damage. Keep containers tightly closed. Do not get in eyes, on skin, or on clothing. Remove contaminated clothing and wash before reuse.

Section VIII - Exposure Controls/Personal Protection

Respiratory Protection: Only respirators approved by MSHA or NIOSH are permissible. Only non-oxidizable sorbents are allowed. A chemical cartridge respirator is not recommended due to the potential for exposure limits being exceeded prior to odor breakthrough. See SUPPLEMENTAL INFORMATION section.

Respirator Selection

100 ppm or less (250 mg/m³ or less): GMOV/S/SAF/SCBAF/SA:PD,PP,CF

100 ppm or greater (250 mg/m³ or greater), or entry and escape from unknown concentrations: GMS/SCBA

Ventilation: Ventilation sufficient to reduce mists and nitrogen oxide concentrations below permissible TLV levels. Mechanical exhaust systems or closed ventilated systems may be required. Always keep the nitric acid vapor concentration levels below 2 ppm (5 mg/m³).

Protective Clothing: Impervious clothing should be used to prevent any possibility of physical contact with liquid nitric acid. Clothing may include a rubber acid suit, hood, boots and gloves, and an air mask and chemical goggles.

Eye Protection: Splash-proof safety goggles should be used if the possibility of liquid nitric acid contacting the eyes exists. Do not wear contact lenses. Eight-inch minimum face shields should be used.

Other Protective Clothing or Equipment: N/A

Work/Hygienic Practices: Facilities for quick drenching of the body, in addition to an eye-wash fountain, should be provided within the immediate work area for emergency use. Employees who handle nitric acid should wash their hands before eating, smoking, or using toilet facilities.

Section IX - Physical and Chemical Properties

Physical State: Liquid

pH: 1-2

% Acid in Solution:	30	40	56-71
Melting Point/Range:	-42°C@68%	-44°F	31°F

Appearance/Color/Odor: Watery liquid, colorless, yellow, or red fuming liquid with a suffocating, acrid odor.

Solubility in Water: 100%

Molecular Weight: 63 (solute)

% Acid in Solution	30	40	56-71
Vapor Pressure(mmHg)	5-10	<3@70°F	2.9@68°F

% Acid in Solution	30	40	56-71
Specific Gravity(Water=1)	1.18-1.19	1.2-1.41	1.41

% Acid in Solution	30	40	56-71
Vapor Density(Air=1)	> 1	< 3	1.5-1.7

% Acid in Solution	30	40	56-71
Weight/Gallon (Lbs.)	9.8-9.9	10-11	11.7

Evaporation Rate (N-Butyl Acetate=1): < 1

% Volatiles: 100% (by volume)

Boiling Point/Range: 244-251°F @ 68%

How to detect this compound : N/A

Section X - Stability and Reactivity

Stability: Stable

Hazardous Polymerization: N/A

Conditions to Avoid: Avoid exposure to direct sunlight.

Materials to Avoid: Most metals, metallic powders, alcohol, charcoal, turpentine, hydrogen sulfide, wood excelsior, paper, cotton and similar organic materials. Alkalies, carbon, carbonates, cyanides, diborane organic chemicals, fluorine, phosphine, sulfides, thiocyanates. Nitric Acid is corrosive or incompatible with many common materials including mild steel, PVC, Viton®, and rubber. Viton® is a registered trademark of DuPont Dow Elastomers.

Hazardous Decomposition Products: Toxic gases and vapors such as Nitrogen Oxides.

Section XI - Toxicological Information

Nitric acid vapor or mist is an irritant of the eyes, mucous membranes, and skin. When nitric acid is exposed to air or comes in contact with organic matter, it decomposes

to yield a mixture of toxic oxides of nitrogen, including nitric oxide and nitrogen dioxide. Exposure to high concentrations of nitric acid vapor or mist causes pneumonitis and pulmonary edema which may be fatal; onset of symptoms may be delayed for 4 to 30 hours. In contact with the eyes, the liquid produces severe burns which may result in permanent damage and visual impairment. On the skin, the liquid or concentrated vapor produces immediate, severe and penetrating burns; concentrated solutions cause deep ulcers and stain the skin a bright yellow or yellowish brown color. The vapor and mist may erode the exposed teeth. Ingestion of the liquid will cause immediate pain and burns of the mouth, esophagus, and gastrointestinal tract.

Section XII - Ecological Information

N/A

Section XIII - Disposal Considerations

Nitric acid may be disposed of by neutralizing with water and alkaline material (such as soda ash, lime, etc.) and disposing in a secured sanitary landfill. Disposal of nitric acid may be subject to federal, state, and local regulations. Users of this product should review their operations in terms of applicable federal, state, and local laws and regulations, then consult with the appropriate regulatory agencies before discharging or disposing of waste material.

Section XIV - Transport Information

DOT Proper Shipping Name: NITRIC ACID

DOT Hazard Class/ I.D. No.: 8, UN2031, II

Section XV - Regulatory Information

Reportable Quantity: 1000 Pounds (454 Kilograms) (85 Gals.)

NFPA Rating: Health - 3; Fire - 0; Reactivity - 0; Other - (Oxidizer)

0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

Carcinogenicity Lists: No NTP: No IARC Monograph: No OSHA Regulated: Yes

Section 313 Supplier Notification: This product contains the following toxic chemical(s) subject to the reporting requirements of SARA TITLE III Section 313 of the Emergency Planning and Community Right-To Know Act of 1986 and of 40 CFR 372:

<u>CAS #</u>	<u>Chemical Name</u>	<u>% By Weight</u>
7697-37-2	Nitric Acid	30-71%

Section XVI - Other Information

Synonyms/Common Names: Aqua Fortis; Hydrogen Nitrate; HNO₃

Chemical Family/Type: Inorganic acid

Section changed since last revision: I, X

IMPORTANT! Read this MSDS before use or disposal of this product. Pass along the information to employees and any other persons who could be exposed to the product to be sure that they are aware of the information before use or other exposure. This MSDS has been prepared according to the OSHA Hazard Communication Standard [29 CFR 1910.1200]. The MSDS information is based on sources believed to be reliable. However, since data, safety standards, and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, Hill Brothers Chemical Company makes no warranty, either expressed or implied, with respect to the completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. Also, additional information may be necessary or helpful for specific conditions and circumstances of use. It is the user's responsibility to determine the suitability of this product and to evaluate risks prior to use, and then to exercise appropriate precautions for protection of employees and others.

HOME PAGE



MATERIAL SAFETY DATA SHEET

PRODUCT NAME: HEXANE

1. Chemical Product and Company Identification

BOC Gases,
Division of
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974

BOC Gases
Division of
BOC Canada Limited
5975 Falbourn Street, Unit 2
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (908) 464-8100
24-HOUR EMERGENCY TELEPHONE NUMBER:
CHEMTREC (800) 424-9300

TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE NUMBER:
(905) 501-0802
EMERGENCY RESPONSE PLAN NO: 2-0101

PRODUCT NAME: HEXANE

CHEMICAL NAME: Hexane

COMMON NAMES/SYNONYMS: Hexane/mixed isomers, Hexanes, n-Hexane

TDG (Canada) CLASSIFICATION: 3

WHMIS CLASSIFICATION: B2, D2B

PREPARED BY: Loss Control (908)464-8100/(905)501-1700

PREPARATION DATE: 6/1/95

REVIEW DATES: 11/15/01

2. Composition, Information on Ingredients

EXPOSURE LIMITS¹:

INGREDIENT	% VOLUME	PEL-OSHA ²	TLV-ACGIH ³	LD ₅₀ or LC ₅₀ Route/Species
Hexane FORMULA: C ₆ H ₁₄ CAS: 110-54-3 RTECS #: MN9275000	100.0	500 ppm TWA (n-Hexane)	50 ppm TWA (n-Hexane) (skin)	LD ₅₀ : 2870 mg/kg Ingestion/rat

¹ Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

³ As stated in the ACGIH 2001 Threshold Limit Values for Chemical Substances and Physical Agents.

IDLH: 1100 ppm (10% LEL)

OSHA Regulatory Status: This material is classified as hazardous under OSHA regulations.

3. Hazards Identification

EMERGENCY OVERVIEW

Clear flammable liquid with gasoline type odor. Dangerous fire and explosion hazard. Avoid heat, sparks, and flames. Vapors irritating to the eyes and respiratory system. Skin contact may cause irritation, dermatitis, and toxic symptoms. Inhalation of vapors may depress the central nervous system causing dizziness, headache and nausea and eventual loss of consciousness and respiratory paralysis at very high concentrations.

MSDS: G-38

Revised: 11/15/01

Page 1 of 7

PRODUCT NAME: HEXANE

ROUTE OF ENTRY:

Skin Contact Yes	Skin Absorption Yes	Eye Contact Yes	Inhalation Yes	Ingestion Yes
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HEALTH EFFECTS:

Exposure Limits Yes	Irritant Yes	Sensitization No
Teratogen No	Reproductive Hazard No	Mutagen Yes
Synergistic Effects None reported		

Carcinogenicity: -- NTP: No IARC: No OSHA: No

EYE EFFECTS:

Contact with liquid will cause irritation, redness and a burning sensation. Persons with potential exposure to hexane should not wear contact lenses.

SKIN EFFECTS:

Hexane is an irritant to the skin and can be absorbed through the skin in harmful amounts.

INGESTION EFFECTS:

Ingestion may cause gastrointestinal irritation, nausea, vomiting and headache.

INHALATION EFFECTS:

Inhalation of the vapors may depress the central nervous system causing dizziness, difficulty in walking, respiratory tract irritation, numbness of the extremities and may result in eventual respiratory paralysis at very high concentrations. Symptoms may include headaches, weakness in the fingers and toes, blurred vision, appetite and weight loss, nausea, and throat irritation.

Some evidence indicates hexane may cause mutagenic, teratogenic, and/or reproductive effects

CHRONIC: Repeated exposure to n-hexane may damage the nervous system causing peripheral neuropathy often characterized by weakness and numbness in the arms and legs. Symptoms generally disappear within a few months after exposure stops.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Any type of paresthesia may be aggravated by hexane exposure.

NFPA HAZARD CODES

Health: 1
Flammability: 3
Instability: 0

HMIS HAZARD CODES

Health: 1
Flammability: 3
Reactivity: 0

RATINGS SYSTEM

0 = No Hazard
1 = Slight Hazard
2 = Moderate Hazard
3 = Serious Hazard
4 = Severe Hazard

4. First Aid Measures

EYES:

Flush contaminated eye(s) with copious quantities of water. Part eyelids with fingers to assure complete flushing. Continue for minimum of 15 minutes. Seek medical attention.

SKIN:

MSDS: G-38

Revised: 11/15/01

PRODUCT NAME: HEXANE

Flush affected area with large quantities of water. Remove contaminated clothing as rapidly as possible. If irritation persists or systemic poisoning is suspect, seek immediate medical attention.

INGESTION:

Do not induce vomiting as aspiration into the lung may cause pulmonary edema and complications. Do not administer milk, alcohol or fatty foods. Lay victim down in a cool, quiet, well ventilated area and keep warm with a blanket. Consult a poison control center for instructions as soon as possible.

INHALATION:

Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. If breathing is difficult, administer oxygen. Unconscious persons should be moved to an uncontaminated area and given artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO HEXANE. Rescue personnel should be equipped with self-contained breathing apparatus and be aware of extreme fire and explosion hazard.

5. Fire Fighting Measures

Conditions of Flammability: Liquid and vapor flammable		
Flash point: -7 °F (-22 °C)	Method: Not Available	Autoignition Temperature: Not Available
LEL(%): 1.2	UEL(%): 7.4	
Hazardous combustion products: Typical for burning hydrocarbon		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: Not Available		

FIRE AND EXPLOSION HAZARDS:

Flammable liquid. Vapors are heavier than air and may travel along the ground to an ignition source and flash back. Vapors may accumulate in areas with inadequate ventilation possibly forming an explosive atmosphere. Use adequate ventilation to prevent vapor buildup. Drum may rupture violently from pressure when involved in a fire situation.

EXTINGUISHING MEDIA:

Foam, dry chemical, carbon dioxide. Water may be ineffective.

FIRE FIGHTING INSTRUCTIONS:

If possible, stop flow of hexane. Use water spray to cool surrounding containers. Firefighters should wear respiratory protection (SCBA) and full turnout or Bunker gear. Use water spray to knock down vapors and cool and protect exposed materials. Continue to cool fire-exposed containers until well after flames are extinguished.

6. Accidental Release Measures

Immediately extinguish all ignition sources and evacuate all personnel from affected area. No smoking, flames, sparks, or flares in hazard area. Ventilate hazard area. Use water spray to knock down vapors. Use appropriate protective equipment. Absorb small spills with suitable inert sorbent material (i.e.: sand or vermiculite) and place in clean dry tightly closed container for later disposal. Dike with inert sorbent well ahead of larger spills for later disposal or recycle. Prevent entryway into waterways and sewers. Hexane may cause a fire or explosion in sewers not specifically designed to prevent vapor buildup. If large amounts are spilled, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

7. Handling and Storage

Electrical Classifications:

Class 1, Group not specified.

Use only non-sparking tools and equipment, especially when opening and closing containers of n-Hexane. Ground and bond metal containers used in the transfer of 5 gallons or more of n-hexane.

Use only in well-ventilated areas. Protect containers from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas, emergency exits, and oxidizers. Drums should be tightly closed and stored upright and firmly secured to prevent falling or being knocked over. Segregate full and empty drums. Use a "first in-first out" inventory system to prevent full drums being stored for excessive periods of time. Post "NO SMOKING OR OPEN FLAMES" signs in the storage area or use area. There should be no sources of ignition in the storage or use area.

Empty containers may contain product residue and flammable vapors. Do not compact, heat, or weld empty containers. Do not re-use containers. Wash hands thoroughly after handling and before meals and breaks. If skin contact is anticipated, wear appropriate protective gloves, apron, etc. as necessary to prevent contact. Change contaminated clothing promptly due to fire and skin absorption hazard. Use only with adequate ventilation.

8. Exposure Controls, Personal Protection

ENGINEERING CONTROLS:

Use local exhaust ventilation in combination with enclosed processes as necessary to control n-hexane levels at or below acceptable exposure guidelines.

EYE/FACE PROTECTION:

Chemical safety goggles or glasses and face shield. Do not wear contact lenses.

SKIN PROTECTION:

Wear protective gloves, apron, etc. of nitrile rubber or polyvinyl alcohol as necessary to prevent contact.

RESPIRATORY PROTECTION:

Positive pressure air line with full-face mask and escape bottle or self-contained breathing apparatus should be available for emergency use.

OTHER:

Emergency eyewash station and shower facilities

9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Liquid	
Vapor pressure at STP	: 2.5	Psia
Vapor density at STP (Air = 1)	: 3.0	
Evaporation point	: Not Available	
Boiling point	: 156	°F
	: 69	°C
Freezing point	: -140	°F
	: -95.6	°C
PH	: Not Available	
Specific gravity	: 0.664	
Oil/water partition coefficient	: Not Available	
Solubility (H ₂ O)	: Negligible	
Odor threshold	: Not Available	
Odor and appearance	: Clear liquid with mild solvent odor	

10. Stability and Reactivity

STABILITY:

Stable

INCOMPATIBLE MATERIALS:

May react violently with strong oxidizers.

HAZARDOUS POLYMERIZATION:

Will not occur.

11. Toxicological Information

INHALATION:

In humans, inhalation of 5000 ppm n-hexane for 10 minutes produced dizziness and giddiness while 2000 ppm caused no effects.

SKIN AND EYE:

No evidence of eye or mucous membrane was reported following exposure of unacclimated human subjects to 5000 ppm n-hexane.

CHRONIC:

Repeated exposure to n-hexane can cause slow-developing bilateral, symmetrical, peripheral and sensorimotor neuropathy. The minimum levels of n-hexane which are neurotoxic to humans have not been established.

REPRODUCTIVE:

Studies indicate that n-hexane can adversely affect the fetus at maternally toxic levels. Toxicity was observed in newborn following experimental 10,000 ppm, 7 hour exposure in female rats. Toxic effects were observed in embryo and fetus following 5000 ppm, 20 hour exposure in female rats. Toxic effects were also observed to embryo and fetus of orally exposed mice.

REPRODUCTIVE (continued):

PRODUCT NAME: HEXANE

Although progressive testicular toxicity has been induced in rats at subneurotoxic doses of the main toxic metabolite of n-hexane (2,5-hexanedione), no reports of human reproductive toxicity or sterility have been associated with n-hexane exposure.

MUTAGENECITY:

Genetic effects observed in mammalian cell analysis system.

OTHER:

Toxic effects observed to respiratory system, nervous systems in experimental exposures mammalian species. Effects include changes in brain weight, body weight and peripheral nervous system changes.

12. Ecological Information

No data given.

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Hexanes	Hexanes
HAZARD CLASS:	3	3
IDENTIFICATION NUMBER:	UN 1208	UN 1208
SHIPPING LABEL:	FLAMMABLE LIQUID	FLAMMABLE LIQUID

Additional Marking Requirement: If net weight of product $\geq 5,000$ pounds, the container must be also marked with the letters "RQ".

Packing Group: II

15. Regulatory Information**SARA TITLE III NOTIFICATION AND INFORMATION:**

Releases of hexane in quantities equal to or greater than the reportable quantity (RQ) of 5,000 pounds are subject to reporting to the National Response Center under CERCLA, Section 304 SARA Title III.

SARA TITLE II-HAZARD CLASSES:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard

PRODUCT NAME: HEXANE

SARA TITLE III - SECTION 313 SUPPLIER NOTIFICATION:

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

CAS NUMBER	INGREDIENT NAME	PERCENT BY VOLUME
110-54-3	Hexane	100.0

This information must be included on all MSDSs that are copied and distributed for this material.

16. Other Information

ACGIH	American Conference of Governmental Industrial Hygienists
DOT	Department of Transportation
IARC	International Agency for Research on Cancer
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act
STEL	Short Term Exposure Limit
TDG	Transportation of Dangerous Goods
TLV	Threshold Limit Value
WHMIS	Workplace Hazardous Materials Information System

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

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APPENDIX C

BOATING OPERATIONS

EHS 6-6: Boating (Previously HS6-7)

Purpose

The purpose of this program is to establish minimum requirements for boating safety.

Version Date: 03/24/1998 - Revised

Original Issue 02/01/95

Date:

Department/Category: Environmental, Health & Safety -
Programs

Document Type: Procedure

Keyword Index: Field Activities/Science, Training

Approved by:



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1.0 PURPOSE

The purpose of this program is to establish minimum requirements for boating safety.

2.0 SCOPE

This procedure applies to all Foster Wheeler Environmental Corporation (FWENC) projects.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with FWENC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director, Administration and Compliance.

4.0 DEFINITIONS

4.1 Boat

Any powered or nonpowered watercraft utilized for the transport of personnel on a body of water.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Line Management

The Project Manager (PM) is responsible for coordinating with the appropriate FWENC Project Environmental and Safety Manager (PESM) to implement the requirements of this procedure. The PM shall provide the necessary management support and allocate sufficient project resources to permit project personnel to operate boats in a safe manner.

Site managers and supervisors are responsible for implementation of this boating safety program in the field.

5.1.2 Environmental, Health and Safety Personnel

The PESM shall ensure that the requirements of this program are incorporated into site Environmental Health and Safety (EHS) plans.

5.2 General Requirements

5.2.1 Boat Operators

FWENC personnel who will operate a boat during the course of a project shall first demonstrate to the site manager that they are experienced in operating boats similar to those used for the project and that they are knowledgeable of the U.S. Coast Guard Boating Safety requirements (33 CFR Subchapter S). **Project boats shall be operated by experienced boat operators only.** Boat operators shall also possess basic mechanical knowledge necessary to troubleshoot common mechanical problems that can and do occur. The boat operator shall be responsible for the safety of all personnel on board the boat he or she is operating and for the integrity of all boat and safety equipment.

Each designated boat operator shall give a safety briefing to all occupants of the boat prior to leaving the shore. **Boats are to be occupied during use by not less than one qualified operator plus one additional person.**

5.2.2 Boat Passengers

Project personnel riding as passengers in a boat shall comply with U.S. Coast Guard requirements presented below.

5.3 Float Plan

The Environmental and Safety Supervisor (ESS) or SM/FOL shall be aware of the location of all project boats and personnel using them at all times. If several boats and crews are involved or are traveling to remote areas, each designated boat operator shall file a written float plan with the ESS or SM/FOL. The float plan shall include the following:

- The names of the boat operator and passengers;
- A description and registration numbers of the boat;
- Radio call sign or cellular telephone number if boat is so equipped;
- A trip itinerary with expected time of return; and
- Steps the ESS or SM/FOL will take to initiate a search response if the expected time of return is exceeded.

5.4 Boat Registration and Numbering

The ESS or SM/FOL shall ensure that all project boats meet U.S. Coast Guard or state boat registration and numbering requirements. The US Coast Guard requires that all motorized boats be numbered in the state of principal use. Many states also require that certain non-motorized boats be numbered (sailboats, rafts, and dinghies). A valid certificate of number showing the numbers issued to the boat is required to be on board the boat whenever the boat is in use. Boat registration numbers are required to be painted or permanently attached to each side of the forward half of the boat. Boat registration must be updated annually.

5.5 U.S. Coast Guard-Approved Equipment

All FWENC project boats will meet or exceed U.S. Coast Guard requirements for safety equipment. These requirements are summarized below for small craft (less than 12 meters in length). The ESS or SM/FOL shall consult with the PESM if larger craft are required.

5.5.1 Flame Arresters

All gasoline engines, except outboard motors, installed in a boat must have an approved flame arrestor (backfire preventer) fitted to the carburetor.

5.5.2 Sound Signaling Devices

Although not required for small craft, all FWENC boats shall carry at least one air horn or similar sound-signaling device.

5.5.3 Personal Flotation Devices

All FWENC personnel and passengers shall wear an approved personal flotation device (PFD) at all times when operating or being transported in a boat. A positively buoyant wet suit or dry suit may be substituted for a PFD. PFDs shall be Type II or higher (capable of turning its wearer in a vertical or slightly backward position in the water). In addition, each boat shall be equipped with at least one Type IV PFD, designed to be thrown to a person in the water and grasped and held by the user until rescued. A buoyant boat cushion equipped with straps and a float ring are two common examples of a Type IV PFD.

5.5.4 Fire Extinguishers

Each boat used by FWENC personnel shall carry at least one Type B-I or B-II fire extinguisher (for use in gasoline, oil and grease fires) approved by Underwriters Laboratories (UL). Each fire extinguisher shall be inspected by the ESS or SM/FOL at least every 6 months to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately.

5.5.5 Navigation Lights

Each boat operated at night shall be equipped with navigation lights and these lights shall be utilized at all times when operating between sunset and sunrise. Navigational lighting shall be in compliance with U.S. Coast Guard requirements. Boats shall be operated at reduced speeds at night and when visibility is reduced.

5.5.6 Visual Distress Signals

All FWENC boats shall carry a selection of pyrotechnic and nonpyrotechnic visual distress signals. Pyrotechnic visual distress signals include red flares, orange smoke, and aerial red meteor or parachute flares. Nonpyrotechnic visual distress signals include an orange distress flag and a flashlight or other electric distress light. No single signaling device is ideal under all conditions and for all purposes. Pyrotechnic visual distress signals shall not be used past the expiration date stamped on them.

5.5.7 Pollution Control

The Refuse Act of 1989 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States. The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances in quantities that may be harmful into U.S. navigable waters. No person may intentionally drain oil or oily wastes from any source into the bilge of any vessel. Larger vessels equipped with toilet facilities must be equipped with a U.S. Coast Guard-approved marine sanitation device.

FWENC employees shall report any significant oil spills to water to the PESM who must report the spill to the U.S. Coast Guard or other applicable regulatory agency. The procedure for incident reporting and investigation shall be followed when reporting the spill. (See EHS 1-7, Incident Reporting and Investigation).

5.6 Load Capacity

Boats shall not be loaded (passengers and gear) beyond the weight capacity printed on the U.S. Coast Guard information plate attached to the stern. In addition, several factors must be considered when loading a boat: distribute the load evenly, keep the load low, do not stand up in a small boat or canoe, and do not overload the boat.

5.7 Tool Kit

All FWENC motorized boats shall carry a tool kit sufficient for the boat operator to troubleshoot common mechanical problems such as fouled spark plugs, flooded carburetor, electrical shorts, etc. Boats operated in remote areas shall also carry appropriate spare parts (propellers, shear pins, patch kits, air pumps, etc). The tool kit shall be maintained by the boat operator and supplies used up shall be replaced immediately.

5.8 Survival Kit

All FWENC boats utilized in remote areas shall carry a survival kit. The survival kit shall contain, at a minimum, a first aid kit, high-energy canned or preserved foods, drinking water, blankets, a heat source, signaling devices, waterproof matches, and other items as necessary to ensure survival for a minimum of 24 hours for the entire crew. Survival suits may be required by the EHS plans for operations in cold environments.

5.9 Communications

All FWENC boats operated in remote areas shall carry a two-way radio or cellular telephone that enables communication back to the field camp or other pre-established location. Exceptions to this requirement must be negotiated with the PESM.

5.10 Boating Accident Report

The U.S. Coast Guard requires filing of a boating accident report within 24 hours of an accident. FWENC personnel involved in a boating accident shall follow the procedure outlined in EHS plans and EHS 1-7, Incident Reporting and Investigating for accident and injury reporting. This procedure will provide for proper notification of the U.S. Coast Guard.

5.11 Good Housekeeping

FWENC personnel using a boat shall properly stow and secure all gear and equipment against unexpected shifts when underway. Decks and open spaces must be kept clear and free from clutter and trash to minimize slip, trip, and fall hazards.

5.12 Fuel Management

FWENC personnel shall utilize the "one-third rule" in boating fuel management. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.

5.13 Training

Boat operators shall be trained on and knowledgeable of U.S. Coast Guard boating safety requirements.

All operators and passengers shall be trained on the requirements of this program. Training records shall be maintained in accordance with EHS 1-9, Recordkeeping.

6.0 REFERENCES

U.S. Department of Transportation, U.S. Coast Guard
33 CFR Subchapter S, Boating Safety

Environmental Health & Safety - Programs Procedure EHS 1-7, Incident Reporting
and Investigation

Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping

FOSTER WHEELER ENVIRONMENTAL CORPORATION

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Proprietary Information

APPENDIX D

ACTIVITY HAZARD ANALYSES

ACTIVITY HAZARD ANALYSIS

Project: <u>West Branch of Calumet River</u> Activity: <u>SITE MOBILIZATION/DEMOBILIZATION</u>		Location: <u>East Chicago, Indiana</u> Analysis approved by: <u>Steve Frost</u>
MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Mobilization/demobilization of equipment and supplies	1. Back Injuries	1. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
2. Establish Site security, work zones and staging areas	2. Slips/Trips/Falls	2. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	3. Overhead Hazards	3. Personnel will be required to wear hard hats that meet ANSI Standard Z89.1.
	4. Dropped Objects	4. Steel toe boots meeting ANSI Standard Z41 will be worn during all site activities.
	5. Noise	5. Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); SHSO will determine the need for hearing protection; all equipment will be equipped with manufacturer's required mufflers.
	6. Heavy Equipment Movement	6. Only trained personnel will operate equipment. A spotter will be used at all times during movement. The operator shall perform the operational safety check prior to the commencement of activities.
	7. Pinch/Cut/Slash	7. Use hand tools properly and wear appropriate protective equipment, cut resistant work gloves will be worn when dealing with sharp objects; all hand and power tools will be maintained in safe condition; guards will be kept in place while using hand and power tools.
	8. Overhead Utilities	8. All overhead utilities will be identified prior to equipment operations; no equipment or personnel closer than 10 feet to energized electrical lines or unprotected/ unshielded circuits or similar structures.
	9. Biological Hazards	9. Wear light colored clothing and insect repellent; Follow procedure for tick bites in Section 10.5; Conduct awareness training regarding poisonous plants and insects; Notify SHSO if you are allergic to insect bites and stings or poisonous plants.
	10. Temperature Extremes	10. Drink plenty of fluids; train personnel of signs/symptoms of heat/cold stress; monitor air temperatures when extreme weather conditions are present; stay in visual and verbal contact with your buddy; and use Temperature Extremes program EHS 4-6.
	11. Hand and Power Tools	11. Daily inspections will be performed; remove broken or damaged tools from service; use the tool for its intended purpose; and use in accordance with manufacturer's instructions.
	12. Inclement Weather	12. Monitor weather conditions daily.

ACTIVITY HAZARD ANALYSIS

Project: <u>West Branch of Calumet River</u>		Location: <u>East Chicago, Indiana</u>
Activity: <u>SAMPLING OPERATIONS</u>		Analysis approved by: <u>Steve Frost</u>
MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Collect subsurface soil samples using Vibracore.	1. Slips/Trips/Falls	1. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	2. Chemical Hazards	2. Appropriate protective clothing per Table 6-1 will be worn during drilling and sampling operations; skin will be rinsed with water if contact with hazardous material occurs; a portable eye wash station will be located by work area; conduct hazard communication training for decontamination and sample preservation chemicals. Follow good personal hygiene practices.
	3. Overhead Hazards	3. All overhead utilities will be identified prior to equipment operations; no equipment or personnel closer than 10 feet to energized electrical lines or unprotected/ unshielded circuits or similar structures.
	4. Dropped Objects	4. Steel toe boots meeting ANSI Standard Z41 will be worn during all site activities.
	5. Noise	5. Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); SHSO will determine the need for hearing protection; all equipment will have manufacturer's required mufflers.
	6. Heavy Equipment Operation	6. Only trained personnel will operate equipment. A spotter will be used at all times during movement. Operator shall perform operational safety prior to the commencement of activities.
	7. Pinch/Cut/Slash	7. Use hand tools properly and wear appropriate protective equipment, cut resistant work gloves will be worn when dealing with sharp objects; all hand and power tools will be maintained in safe condition; guards will be kept in place while using hand and power tools.
	8. Fire/ Explosion	8. ABC type fire extinguishers shall be readily available. No smoking in work area. Bond and ground portable generator and gasoline can when refilling generator with fuel.
	9. Biological Hazards	9. Wear light colored clothing and insect repellent; Follow procedure for tick bites in Section 10.5; Conduct awareness training regarding poisonous plants and insects; Notify SHSO if you are allergic to insect bites and stings or poisonous plants.
	10. Temperature Extremes	10. Drink plenty of fluids; train personnel of signs/symptoms of heat/cold stress; monitor air temperatures when extreme weather conditions are present; stay in visual and verbal contact with your buddy; and use Temperature Extremes program EHS 4-6.
	11. Hand and Power Tools	11. Daily inspections will be performed; remove broken or damaged tools from service. Use the tool for its intended purpose; and use in accordance with manufacturer's instructions. Ensure water-proof extension cords are used to power equipment.
	12. Inclement Weather	12. Monitor weather conditions daily.

Project: <u>West Branch of Calumet River</u>		Location: <u>East Chicago, Indiana</u>
Activity: <u>WORKING ON OR NEAR WATER</u>		Analysis approved by: <u>Steve Frost</u>
MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Sampling Operations over water (for hazards related to Vibracore operations, see Vibracore AHA)	1. Chemical hazards.	1. Wear the appropriate PPE per Table 6-1. Practice contamination avoidance. Conduct real-time air monitoring. Follow proper decontamination procedures. Ensure sample containers are properly decontaminated before handling them. Wash hands/face before eating, drinking or smoking.
2. Sampling Near Streams.	2. Slips/Trips/Falls	2. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
3. Sample handling	3. Drowning	3. A buddy/ rescue person shall be on shore during all activities when personnel are in the water. A throwable flotation device shall be available. Wear PFD when working on or near water deeper than 1 foot.
4. Operating Marsh Buggy	1. Falling out of passenger compartment 2. Being struck by vehicle 3. Assembling vehicle using forklift and other tools	1. Wear seat belts at all times when vehicle is in motion. 2. Do not lean out over edge of passenger compartment 3. Drive vehicle at moderate speeds and avoid sharp turns 4. Wear PFDs if operating vehicle in water that is deep enough to pose a drowning hazard. 1. Ensure backup alarm is functional before operating 2. Set parking brake and chock wheels when parked 3. Maintain eye contact with operator at all times 4. Ground personnel must stay a safe distance away from vehicle when it is operating. 5. Ensure all vehicle operators have been properly trained 1. Ensure stable contact / attachment point when lifting vehicle with forklift. 2. Assemble vehicle on level, stable ground. 3. Keep personnel away from equipment when lifting. 4. Use jack stands or cribbing to support vehicle once it is lifted if it is necessary to crawl under any part the vehicle which could present a crush hazard if it were to fall. 5. Ensure only trained and certified forklift operators operate forklift. 6. Inspect all tools before use. 7. Use proper lifting techniques when picking up heavy loads; don't lift more than 50lbs; use mechanical lifting devices as appropriate; have other help lift heavy objects.

Project: <u>West Branch of Calumet River</u>		Location: <u>East Chicago, Indiana</u>
Activity: <u>DECONTAMINATION</u>		Analysis approved by: <u>Steve Frost</u>
MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Decontaminate personnel	1. Chemical Hazards.	1. Wear the appropriate PPE per Table 6-1. Practice contamination avoidance. Conduct real-time air monitoring. Follow proper decontamination procedures. Ensure sample containers are properly decontaminated before handling them. Wash hands/face before eating, drinking, or smoking.
2. Decontaminate equipment	2. Slips/Trips/Falls	2. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	3. Overhead Hazards	3. Personnel will be required to wear hard hats that meet ANSI Standard Z89.1.
	4. Dropped Objects	4. Steel toe boots meeting ANSI Standard Z41 will be worn during all Site activities.
	5. Noise	5. Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); SHSO will determine the need for hearing protection; all equipment will be equipped with manufacturer's required mufflers.
	6. Back Injuries	6. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	7. Splashing	7. Wear safety goggles when collecting and handling samples and during well development.
	8. Temperature Extremes	8. Drink plenty of fluids; train personnel of signs/symptoms of heat/cold stress; monitor air temperatures when extreme weather conditions are present; stay in visual and verbal contact with your buddy; and use Temperature Extremes program EHS 4-6.
	9. Inclement Weather	9. Monitor weather conditions daily.
	10. Manual Lifting	10. Use proper lifting techniques. Team lifting will be used for heavy loads or use mechanical lifting devices.

Project: <u>West Branch of Calumet River</u>		Location: <u>East Chicago, Indiana</u>
Activity: <u>SAMPLE PREPARATION</u>		Analysis approved by: <u>Steve Frost</u>
MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Removing core sample from core tubes	1. Back Injuries from heavy lifting 2. Contact with contaminated sediments 3. Inhalation of gases and vapors	1. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available. 2. Wear modified Level D PPE. Undergo PPE decontamination. Establish work zones. 3. Conduct air monitoring as specified in Sec. 7.0. Mechanically ventilate work area as appropriate.
2. Examining and preparing core samples for laboratory analysis.	1. Contact with contaminated sediment 2. Inhalation of gases and vapors	1. Wear modified Level D PPE. Undergo PPE decontamination. Establish work zones. 3. Conduct air monitoring as specified in Sec. 7.0. Mechanically ventilate work area as appropriate.

APPENDIX E

EHS FORMS

FOSTER WHEELER ENVIRONMENTAL CORPORATION

MEDICAL DATA SHEET

This brief medical data sheet shall be completed by all on-site personnel and will be kept in the Support Zone by the FOL/SHSO as a project record during the conduct of site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project: _____

Name: _____ Home Telephone: _____

Address: _____

Age: _____ Height: _____ Weight: _____ Blood Type: _____

Name and Telephone Number of Emergency Contact: _____

Drug or Other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

Provide a Checklist of Previous Illnesses: _____

What Medications are you presently using? _____

Do You Have Any Medical Restrictions? _____

Name, Address, and Phone Number of Personal Physician: _____

FOSTER WHEELER ENVIRONMENTAL CORPORATION

WEEKLY HEALTH AND SAFETY REPORT

Project Name: _____	
Location: _____	
Delivery Order No. _____	
SITE INFORMATION	INJURIES AND ILLNESSES
Week Ending _____	Yes _____ No _____
Hours Worked _____	Describe and attach reports: _____ _____
Level of Protection B ___ C ___ D ___	
MAJOR ACTIVITIES CONDUCTED THIS WEEK: (Drum handling, sampling, excavation, abatement/T&D, etc.) _____ _____ _____	
SIGNIFICANT EVENTS THIS WEEK: (regulatory visits, equipment malfunctions, process start-up or shutdown): _____ _____ _____	
FUTURE ISSUES: (schedule, manpower allocation, monitoring equipment, other resources needed) _____ _____ _____ _____ _____ _____	
SITE AUDIT/INSPECTIONS CONDUCTED Yes _____ No _____ (describe outstanding findings and attach results) _____ _____ _____ _____	

APPENDIX F

TEMPERATURE EXTREMES PROGRAM

EHS 4-6: Temperature Extremes (Previously HS4-6)

Purpose

The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

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Approved by:



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1.0 PURPOSE

The purpose of this program is to prevent heat and cold stress related injuries and illnesses at field operations.

2.0 SCOPE

This program applies to all Foster Wheeler Environmental Corporation (FWENC) and subcontractor field personnel that may be exposed to heat or cold stress during the performance of their field work assignments.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with FWENC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director, Administration and Compliance.

4.0 DEFINITIONS

4.1 Adjusted Temperature

The dry bulb temperature adjusted to account for solar radiation, to be used as a heat stress indicator for personnel in impermeable protective clothing.

4.2 Deep Frostbite

The tissue beneath the skin is solid to the touch; it may involve a full thickness freeze to the bone. This is an extreme emergency and can result in permanent tissue loss.

4.3 Frostbite

Freezing of body tissue.

4.4 Frostnip or Incipient Frostbite

A cold related injury that progresses slowly and is painless while developing. The victim is usually unaware that he/she has frost nip. The skin first becomes reddened, then changes to white; no freezing of tissue occurs.

4.5 Heat Cramp

Painful muscle spasms usually occurring on the arms, legs, and abdomen; caused by excessive loss of body electrolytes from profuse sweating.

4.6 Heat Exhaustion

A form of shock that occurs when the body loses large amounts of water and electrolytes from excessive perspiration after exposure to heat and physical activity; also called heat prostration.

4.7 Heat Rash

Profuse tiny raised red vesicles (blister-like) on affected areas of the skin which cause a prickling sensation during heat exposure.

4.8 Heat Stroke

A life-threatening condition caused by rapidly rising body core temperature that occurs when the body's temperature regulating mechanisms are overwhelmed. Sweating stops and the skin is dry and hot.

4.9 Hyperthermia

A rise in body core temperature above 99.6 C.

4.10 Hypothermia

Decreased body core temperature from prolonged exposure to freezing or near-freezing temperatures. This is the most life-threatening cold injury and affects the entire body with possible localized severe cooling.

4.11 Superficial Frostbite

Frostbite which affects the skin and tissue just beneath the skin. The skin is firm and waxy, tissue beneath is soft and numb. The skin turns purple and may tingle and burn during warming.

4.12 Wet-Bulb Globe Temperature (WBGT)

Method used to measure the environmental factors (e.g., temperature, relative humidity) which impacts the body's physiological responses to heat.

4.13 Wind-Chill Factor or Equivalent Chill Temperature (ECT)

An index describing the effect of the cooling power of moving air on exposed flesh. The effect of wind velocity at a certain temperature is expressed as the equivalent cooling effect of a lower temperature with still air.

4.14 Work/Rest Regimen

The ratio of time spent working to time spent resting in an area designed to relieve heat related conditions. This ratio is expressed in one hour periods. Example: A work/rest regimen of 75% work, 25% rest corresponds to 45 minutes work, 15 minutes rest each hour.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Field Personnel

All field personnel will be trained in heat and cold stress prevention and treatment. Field personnel will monitor themselves and their workmates for symptoms of heat and cold stress and will inform the Environmental and Safety Supervisor (ESS) or their supervisor immediately should symptoms become apparent.

5.1.2 Line Management

Site Supervisors have the responsibility to:

- Provide resources and facilities necessary to prevent health effects from temperature extremes
- Enforce work rules related to such prevention
- Ensure implementation of the requirements of this program as specified in the Site Environmental, Safety and Health (EHS) plans.

5.1.3 Environmental, Health and Safety Personnel

The Project Environmental and Safety Manager (PESM) will make the initial determination of heat and cold stress prevention requirements as part of the site EHS Plan (see EHS 3-2, EHS Plans) and oversee the implementation of this program on a project basis for all FWENC field programs.

The ESS will assist with implementation of heat and cold stress prevention programs. The ESS will, in most cases, be the person responsible for monitoring heat and cold

stress on the job, determining work/rest and work/warm-up schedules where used, and will implement emergency response or corrective action, if needed. The ESS will train site personnel on the effects of temperature extremes and the site prevention program, and will maintain records related to this program.

5.2 General Program Requirements

Adverse weather conditions must be considered when planning site operations. Excessively hot or cold working environments can produce a number of different injuries. Critical to the ability to care for those injuries is a basic understanding of the way in which the body maintains its temperature and how it physiologically adjusts to extremes of heat and cold. Attachment A provides information on the body's physiological responses to heat and cold stress.

Proper care of victims who are suffering from the effects of heat or cold exposure will help to minimize injuries and speed recovery. On the other hand, improper treatment of these emergencies can result in serious injury, disability, or death.

The most effective first aid for any injury is prevention. When acceptable monitoring and prevention programs are followed, there should be no victims.

5.3 Heat Stress

A heat stress prevention program will be implemented when ambient temperatures exceed 70°F for personnel wearing impermeable clothing and for other personnel when the WBGT index exceeds the ACGIH Threshold Limit Values.

5.3.1 Selection of Chemical Protective Clothing

The PESM will review site data and working conditions and select the personal protective equipment ensemble that best protects the employees from site hazards. The risk of heat related illness will be fully considered in balancing the risks and benefits of the PPE. Where contact with a waste material is unlikely; contact is not expected to result in a serious dermal hazard; and significant absorption of the contaminants is not likely to occur, then impermeable clothing should not be required. In this case, the risk of heat related illness may grossly outweigh the benefits provided by such equipment. Even when chemical protective clothing is needed, the PESM should consider the probable exposure scenarios and select protective equipment accordingly. For example, if dermal exposure is likely to be localized, strong consideration should be given to using gloves, boots, gauntlets, leggings, aprons, bibs, face shields, etc., in lieu of full body coveralls and respirators.

5.3.2 Hydration

FWENC will supply cool (50–59°F) potable water or other suitable drinks (e.g., sport electrolyte replacements) for fluid replacement. Employees involved in the heat stress prevention program will be trained and encouraged to drink at a rate of approximately 8 oz. every 20 minutes. Individual cups will be used and kept in closed containers or dispensers.

5.3.3 Cool Rest Areas

Shaded rest areas will be provided. On large remediation projects, air conditioned rest areas should be provided for workers exposed to heat stress conditions.

5.3.4 Other Prevention Program Elements

The PESM, ESS and the Project Manager will incorporate other elements into the heat stress prevention program as necessary. The selected elements will be described in the EHS plans. Engineering controls are preferred. Where their use is not feasible, the program must incorporate administrative/work practice controls, personal protective equipment, or a combination. Examples of other prevention program elements include:

- **Engineering Controls**

Engineering controls may include:

- Air conditioned cabs for heavy equipment and vehicles (Such controls may eliminate the need for other program elements);
- Fans or blowers; and
- Cold water for drenching personnel in impermeable clothing. This can be provided through a garden hose, a garden sprayer filled with ice water, a clean drum full of water for "hard hat dipping" or containers of ice water and clean towels in the rest area to hasten cool down.

- **Administrative and Work Practice Controls**

Administrative controls include:

- Adjusting work schedules to do the bulk of the work during the cooler parts of the day;
- Acclimatizing workers; and
- Implementing work/rest regimens (See Attachment B for Work/Rest Regimen Procedures).

- **Personal Protective Equipment**

Personal cooling devices which may be useful include:

- Ice vests;
- Circulating water vests; and
- Vortex tubes.

Where ice vests and circulating water vests are used, rest periods of approximately 15 minutes should be taken when ice packs or batteries need to be changed.

Continuous work over long periods of time with these devices may present an increased musculoskeletal injury risk due to the extra weight. Since the duration of the cooling effectiveness of these devices will vary with heat and work loads, users must be instructed to leave the area to replenish ice or batteries at the first sign of loss of cooling.

- **Monitoring**

A program of environmental and physiological monitoring must be established in order to use work/rest regimens. The monitoring procedures are described in Attachment B.

5.3.5 Training

All site personnel must receive training on the following topics:

- Health effects of hot environments and symptoms of heat related illness;
- Personal risk factors;
- Effect of personal protective equipment on heat stress conditions;
- Preventive measures;
- Fluid replacement;
- Elements of the site Heat Stress Prevention Program; and
- First aid and emergency response.

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

5.4 Cold Stress

At certain times of the year, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trenchfoot or immersion foot, and hypothermia as well as slippery surfaces, brittle equipment, poor judgement and taking short cuts. The current ACGIH threshold limit values (TLVs) for cold stress will be used as a guideline. FWENC will implement the following cold stress prevention program elements when there is a potential for cold related injuries.

5.4.1 Personal Protective Equipment

The following personal protective equipment will be provided as necessary to FWENC employees when conditions indicate a potential for cold-related injury. Subcontractors will be expected to supply appropriate equipment to their employees.

- Hard hat liners,
- Gloves or glove liners,

- Rain gear or water impermeable coveralls and gloves for potentially wet operations,
- Fleeced boot liners where rubber steel-toe boots are used, and
- Winter coveralls.

5.4.2 Engineering Controls

A variety of engineering controls shall be evaluated to minimize cold stress. These include:

- General or spot heating should be used to increase temperature at the workplace.
- If fine work is to be performed with bare hands in a cold environment, special provisions should be made to keep the worker's hands warm. Warm air jets, radiant heaters, or contact warm plates can be used.
- The work area should be shielded from winds and drafts that may affect the wind chill factor.
- The air velocity in refrigerated rooms should be minimized as much as possible, and should not exceed 1m/sec in the work zone.
- At temperatures below freezing, metal handles of tools and control bars should be covered with thermal insulating material.
- Unprotected metal chair sets should not be used as they conduct heat away from the body.
- When necessary, equipment and processes should be substituted, isolated, relocated, or redesigned to reduce cold stress at the worksite.
- Power tools, hoists, cranes, or lifting aids should be used to reduce metabolic workload.
- Heated warming shelters such as tents and cabins should be made available if work is performed continuously in an equivalent chill temperature of 20 below.
- The ESS may implement a work-rest schedule to reduce exposure to cold stress.
- Scheduled rest breaks should be enforced.
- Personnel exposed to the cold should be provided the opportunity for frequent intake of warm, sweet, caffeine-free, nonalcoholic liquids or soup.
- Work should be moved to warmer areas whenever possible.
- Extra workers should be assigned to highly demanding tasks.
- Workers should be allowed to pace themselves, taking breaks when needed.

- Workers shall be trained in the prevention, symptoms, and emergency response to cold stress.
- Utilize the "buddy system" to monitor cold stress symptoms among the workers.
- Allow new employees time to adjust or "acclimate" to cold conditions.
- Minimize the need to sit or stand in one place for long periods of time.
- Minimize the amount of work time spent in a cold environment.
- Allow for the weight and bulkiness of protective clothing when estimating work performance goals and tasks.

5.4.3 Warm Rest Areas

FWENC will make warm rest areas, e.g., heated trailers, available for rest breaks in cold weather. Employees will be permitted and encouraged to use the heated trailers whenever they experience symptoms of cold stress.

5.4.4 Work/Warm-up Schedule

The work/warm-up schedule found in the ACGIH TLVs for cold stress will be followed. In addition, FWENC will make warm-up periods available to employees who need to change into dry clothing to prevent immersion foot or hypothermia.

5.4.5 Training

All FWENC employees and subcontractors will be trained in:

- The effects of cold stress, including frostbite, immersion foot and hypothermia;
- Personal risk factors;
- Recognition of the symptoms;
- Methods employees can use to protect themselves; and
- First aid procedures and recognition of medical emergencies.

Records shall be maintained in accordance with EHS 1-9, Recordkeeping.

6.0 REFERENCES


ACGIH (American Conference of Government Industrial Hygienists)
Threshold Limit Values for Chemical Substances and Physical Agents and Biological
Exposure Indices, 1994-95.
NIOSH (National Institute for Occupational Safety and Health)
Occupational Exposure to Hot Environments, Revised Criteria 1986.


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Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.

National Safety Council

Fundamentals of Industrial Hygiene. Third Edition, 1988.

Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping 

Environmental, Health & Safety - Programs Procedure EHS 3-2, Environmental, Health & Safety Plan(s) 

7.0 ATTACHMENTS

Attachment A - Heat and Cold Stress Information

Attachment B - Work/Rest Regimens and Monitoring

ATTACHMENT A (Page 1 of 6)
HEAT AND COLD STRESS INFORMATION



FOSTER WHEELER ENVIRONMENTAL CORPORATION
HEAT AND COLD STRESS INFORMATION

HEAT STRESS

Hot weather can cause physical discomfort, loss of efficiency, and personal injury. The human body strives to maintain a constant core temperature of 98.6°. If this temperature is to be maintained, heat loss must equal heat production. This balance is maintained by variations in the blood flow to the outer part of the body. When the core temperature rises, blood vessels beneath the skin dilate, and the blood brings increased heat to the skin, where it is dissipated by radiation and convection. This works only as long as the skin temperature is lower than the temperature of the outside environment. Heat loss by radiation convection is impossible when the temperature of the outside air approaches or exceeds the temperature of the skin. The body will now rely on dissipation through evaporation of sweat. But the sweat mechanism also has limits. The normal adult can sweat only about one liter per hour and can sweat at that rate for only a few hours at a time. In addition, sweating only works if the relative air humidity is low. Sweat evaporation ceases entirely when the relative humidity reaches 75 percent.

Of particular concern in heat stress monitoring is the use of personal protective clothing which decreases natural body ventilation and greatly increases the temperature and humidity to the skin. If precautions are not taken, heat stress will progress into a heat-related injury. Heat-related injuries fall into three major categories: heat cramps, heat exhaustion, and heat stroke.

Heat Cramps

Symptoms

Heat cramps are the least common and least severe of heat injuries. Heat cramps occur when the electrolytic balance in the blood between water, calcium, and sodium (salt) is altered. Low blood salt level, from profuse sweating and inadequate salt consumption, is the usual cause.

Symptoms of heat cramps include:

- Severe muscle cramps and pain, especially of the upper legs, calves, and abdomen, and occasionally in the arms
- Faintness and dizziness
- Possible nausea and vomiting

Treatment

Emergency care will include:

- Remove victim from the hot environment

ATTACHMENT A (Page 2 of 6)
HEAT AND COLD STRESS INFORMATION

- Dilute one teaspoon of salt in one quart of water or use a commercial product with a low glucose content; allow victim to sip this solution at the rate of one-half glassful every 15 minutes
- To relieve pain, gently stretch the involved muscle group; gently message cramps as long as it does not increase the pain or discomfort

The victim should avoid exertion of any kind for 12 hours. A victim of heat cramps is prone to recurrence.

Heat Exhaustion

Symptoms

Heat exhaustion is the most common heat injury and usually occurs in an individual who is involved with heavy physical exertion in a hot, humid environment, and is wearing protective clothing. Heat exhaustion is a mild state of physical shock caused by the pooling of blood in the vessels just below the skin, causing blood to flow away from the major organs of the body. Due to prolonged and profuse sweating, the body also loses large amounts of salt and water.

The symptoms of heat exhaustion include:

- Profuse sweating
- Pale, cool, sweaty skin
- Headache and extreme weakness, fatigue
- Nausea and possible vomiting
- Dizziness and faintness
- Collapse and possible brief unconsciousness
- Body core temperature normal, may even be slightly below normal

Treatment

Emergency care will include:

- Remove victim from the hot environment and out of the exclusion zone
- Lie victim down with feet slightly raised
- Remove as much clothing as reasonable (especially personal protective clothing); loosen what cannot be removed
- Apply cold, wet compresses to the skin; fanning will also aid in cooling
- If the victim is fully alert, allow him/her to drink water or the same solution, at the same rate, that was used for the emergency care of heat cramps
- If the victim vomits, do not give fluids by mouth, transport him/her to a hospital immediately (dehydration is the most critical problem in heat exhaustion victim; intravenous fluids will have to be given)
- Take oral temperature every 10 minutes, if the victim's temperature is above 101 or shows a steady increase, transport to a hospital immediately and start sponging him/her off with cool water

ATTACHMENT A (Page 3 of 6) HEAT AND COLD STRESS INFORMATION

Heat Stroke

Heat stroke is a true life-threatening emergency having a mortality rate of 20 to 70 percent. This condition results when the heat regulating mechanisms of the body break down and fail to cool the body sufficiently. The body temperature rises to between 105 and 110 F; no sweating occurs in about 50 percent of the victims. Because no cooling takes place, the body stores increasingly more heat, and eventually brain cells are damaged, causing permanent disability or death. About 4,000 Americans die of heat stroke annually.

There are two basic kinds of heat stroke: classic heat stroke and exertional heat stroke. Classic heat stroke, in which people lose the ability to sweat, generally effects the elderly or chronically ill. Exertional heat stroke, in which victims retain the ability to sweat, is accompanied by physical exertion and muscle stress. Exertional heat stroke is the type that will be most commonly encountered on a field operation requiring strenuous physical activity.

The symptoms of heat stroke include:

- Oral temperature of 105 F or higher
- Hot, reddish skin, skin is usually dry
- Headache
- Dry mouth
- Shortness of breath
- Nausea or vomiting
- Increasing dizziness and weakness
- Mental confusion and anxiety; victims may show unusual irritability, aggression, combative agitation, or hysterical behavior
- Convulsions, sudden collapse and possible unconsciousness; all heat stroke victims having varying levels of consciousness, ranging from disorientation to coma

Treatment

Emergency care will include:

- Remove the victim from the hot environment and from the exclusion zone
- Call for trained emergency medical personnel immediately
- Remove as much clothing as reasonable (especially personal protective clothing); cut clothing with bandage scissors, if necessary, being careful not to injure victim
- Pour cool water over the victim, avoiding his nose and mouth
- Fan the victim
- Place cold packs under the arms and against neck and ankles
- Wrap victim in a wet blanket
- Continue a combination of these methods until the oral temperature falls below 103 F (take measures to prevent chilling, if necessary, i.e., use slower cooling if the victim starts shivering)
- Elevate the head and shoulders slightly during cooling
- Never give the victim anything to drink unless fully conscious and vomiting is unlikely
- Because heat stroke involves the entire body, a number of complications may result:
- Brain swelling, convulsions, coma, kidney failure, liver failure, high blood pressure and heart failure.

Therefore, always transport the victim to a hospital even if the body core temperature has

lowered to near normal.

ATTACHMENT A (Page 4 of 6) HEAT AND COLD STRESS INFORMATION

The two most reliable and distinct differences between heat stroke and heat exhaustion are:

Heat Stroke

- Skin flushed (red); may be dry; hot to touch
- Oral temperature above 105°F.

Heat Exhaustion

- Skin pale; wet or clammy; cool to touch
- Oral temperature usually normal.

Cold Stress

Hypothermia is a drop in the core body temperature below 98.6 F. The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold; this is followed by a slowed and sometimes irregular heart beat, a weakened pulse and a drop in blood pressure. Vague or slow slurred speech, memory lapses, apathy, incoherence and drowsiness can occur. Other symptoms may include cool skin, slow, irregular breathing, apparent exhaustion, and fatigue after rest.

Prevention

Hypothermia is caused by prolonged exposure to a cold environment, whether air, water, or snow and ice. Adequate dry clothing with appropriate insulating capacity must be provided to workers to prevent hypothermia, especially if work is performed in air temperatures below 40 F. Wind chill is a critical factor. Work at a slow but steady pace. The job should be a "no sweat" operation.

Unless there are unusual or extenuating circumstances, cold injury to other than the extremities (hands, feet, and head) is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against hypothermia. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered for these workers. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Treatment

First aid for mild hypothermia will be performed as follows:

1. End the exposure - get the victim out of the cold and wet.
2. Replace wet clothing with dry or add insulation to clothing.
3. Offer warm, non-alcoholic fluids.
4. Increase exercise.
5. Seek shelter from wind, wet and cold.

ATTACHMENT A (Page 5 of 6) HEAT AND COLD STRESS INFORMATION

CAUTION: If the victim remains cold for a number of hours, chemical changes may have taken place which, on rewarming, may cause major medical problems for the victim and which could result in death. Severely hypothermic victims are best warmed in the hospital under controlled conditions. If a severely hypothermic victim cannot be transported to a hospital within a few hours, rewarming should begin in the field.

Symptoms

Frostbite can occur either before or after the onset of hypothermia when body tissue (usually an extremity) is exposed to freezing temperatures. Frostbite occurs when the fluids surrounding tissue cells freezes. The danger of frostbite increases with increased wind chill and/or reduced temperatures below 32 F. Frostbite can also occur if tissues are in prolonged contact with a frozen material or object. Skin contact with frozen metal, for example, can result in frostbite in a short period of time, even in a warm environment.

There are three degrees of frostbite:

- First degree - freezing without blistering or peeling, "frostnip"
- Second degree - freezing with blistering and/or peeling, and
- Third degree - freezing resulting in the death of skin tissue and possibly the death of underlying tissues as well

Symptoms of frostbite include the following:

- The skin changes color to white or grayish-yellow, progresses to reddish-violet, and finally turns black as the tissue dies
- Pain may be felt at first, but subsides
- Blisters may appear, and
- The affected area is cold and numb

Prevention

Frostbite can be prevented by wearing sufficient protection to prevent skin from coming into prolonged contact with a freezing environment. The following steps can be taken:

1. Wear sufficient clothing. Mittens are better than gloves. Face masks and wool stocking caps are better than hats. Wind and waterproof hoods protect the face and neck.
2. Clothing should be loose enough to prevent constriction of blood vessels. Boots must be roomy enough to permit movement of the toes with no feeling of tightness.
3. Do not contact conductive metals or contact gasoline or other solvents with bare skin as rapid evaporation of solvents may quickly lead to frozen tissues in a cold environment.
4. Exercise the toes and fingers to maintain circulation.
5. Observe the condition of your partners' face, hands and ears frequently for signs of frostbite.
6. Avoid smoking and drinking alcoholic beverages.

ATTACHMENT A (Page 6 of 6) HEAT AND COLD STRESS INFORMATION

Treatment

First aid for superficial (first degree) frostbite is as follows:

1. Place a warm body part next to the frozen area, applying firm, steady pressure.
2. DO NOT RUB THE AREA. Rubbing may cause further damage to already injured skin.
3. Protect the area from further freezing.

First aid for deep frostbite (second and third degree) is as follows:

1. KEEP THE FROZEN PART FROZEN!
2. Prevent further injury: avoid rubbing and further freezing of unaffected tissue.
3. If the part has thawed, the part should NOT be allowed to refreeze or bear weight. A victim with thawed feet should be carried out.
4. Give the victim plenty of fluids and evacuate to medical assistance as soon as possible.

Symptoms

This condition may be caused by long, continuous exposure to cold without freezing, combined with persistent dampness or actual immersion in water. Edema (swelling), tingling, itching, and severe pain occur, and may be followed by blistering, death of skin tissue, and ulceration. When other areas of the body are affected besides the feet, the condition is known as chilblains.

Prevention

Trenchfoot and chilblains can be prevented by keeping the body as dry as possible at all times. Waterproof boots should be worn when required, but provisions must be made for preventing excessive perspiration to accumulate inside the boots. Socks should be changed at least twice daily and the boots wiped dry inside with each change of socks. The feet should also be wiped dry and foot powder applied.

Treatment

Affected body parts should not be rubbed or massaged, but bathed in water using plain white soap. Dry thoroughly and elevate the body part, allowing the body part to be exposed at room temperatures. If the feet are affected, do not walk during treatment.

ATTACHMENT B (Page 1 of 5)

WORK/REST REGIMENS AND MONITORING



FOSTER WHEELER ENVIRONMENTAL CORPORATION

**HEAT STRESS
WORK/REST REGIMES AND MONITORING**

Introduction

Establishing a work/rest regimen that allows work to be completed in a timely manner while providing adequate rest time to prevent heat stress requires involvement of the ESS, FOL, and individuals involved. In many cases, particularly when wearing normal field type clothing (i.e., level D), awareness and communication are the key elements to a successful program. Allowing rest periods on an "as needed" basis while ensuring vigilance for initial symptoms of heat stress, encourages this success.

There are times when this approach is not appropriate. When heat stress contributing protective clothing (e.g., respirators, impermeable coveralls) are worn for extended periods, or when "as needed" work/rest regimens adversely impact either the individuals exposed to the heat source or work completion, a more formal work/rest regimen will be established.

Formal work/rest regimens are based either on 1) monitoring ambient conditions (e.g., with a WBGT), estimating work loads and establishing work/rest times, 2) monitoring physiological conditions and adjusting work/rest periods, or 3) using personnel heat stress monitors.

The WBGT, physiological monitors, and personnel heat stress monitors will be used in accordance with manufacturer's instructions. Personnel heat stress monitors will be approved for use by the PESM.

II. WBGT Based Work/Rest Regimens

A. Work/Rest Regimens

When required, the WBGT will be used in conjunction with the work load to determine the appropriate work/rest regimen for personnel wearing regular work clothing or semipermeable disposal coveralls (uncoated Tyvek). Light work examples include sitting or standing or performing light hand or arm work. Moderate work includes walking about with moderate lifting and pushing. Heavy work corresponds to pick and shovel-type work.

The work/rest regimen using the WBGT procedure will be used as a guideline. Table B-1 outlines the work/rest regimen guidelines based upon WBGT temperature and work load. Table B-2 identifies the correction factors. The WBGT temperature will be determined in accordance with Section B of this attachment.

ATTACHMENT B (Page 2 of 5)**WORK/REST REGIMENS AND MONITORING****Table B-1.** Examples of Permissible Heat Exposure Threshold Limit Values.
(Values are given in °F WGBT)*

Work - Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	86	80	77
75% Work - 25% Rest, each hour	87	82	78
50% Work - 50% Rest, each hour	89	85	82
25% Work - 75% Rest, each hour	90	88	86

*** Notes on Table B-1**

- 1) These values are for fully acclimatized workers wearing light weight pants and shirts. For conditions other than this use this table with the correction factors from Table B-2.
- 2) These values assume that workers drink frequently and have properly increased salting of food prior to exposure.
- 3) These values are guidelines. Actual levels may be modified based on individual physiological response and actual work and rest conditions.
- 4) These values assume that the rest location is cool enough to alleviate heat load conditions.

ATTACHMENT B (Page 3 of 5)**WORK/REST REGIMENS AND MONITORING****Table B-2.** Correction Factors for Table B-1 in °F*

Clothing Type	WBGT Correction
Summer work uniform	0
Cotton overalls	-3.5
Winter work uniform	-7
Water barrier, permeable	-11
Condition	WBGT Correction
Unacclimatized worker, moderate work load	-4.5

*To use this table, identify the most restrictive applicable clothing type and whether unacclimatized workers are involved. Add the two. Modify Table B-1 temperatures by this amount. For example, the Table B-1 TLV for continuous work, light workload 86°F. If cotton overalls (-3.5) are work and acclimatized workers are acclimatized (no additional change) the modified limit is 82.5°F.

B. WBGT Determination

If the Wet Bulb Globe Temperature (WBGT) is used to determine if field conditions are conducive to heat stress illnesses, the WBGT is determined through the following equations:

- Outdoors with solar load: (1)

$$WBGT = 0.7 NWB + 0.2 GT + 0.1 DB$$

- Indoors or outdoors with no solar load: (2)

$$WBGT = 0.7 NWB + 0.3 GT$$

Where:

WBGT = Wet Bulb Globe Temperature Index

NWB = Natural Wet-Bulb Temperature

DB = Dry-Bulb Temperature

GT = Globe Thermometer Temperature

ATTACHMENT B (Page 4 of 5)

WORK/REST REGIMENS AND MONITORING

The factors involved in the above equations can be measured in the following manner:

- Through the use of a direct-reading heat stress monitor capable of measuring all of the individual factors associated with the WBGT equation. For example, the Reuter-Strokes Wibet No. RSS-214 heat stress monitor.
- By measuring the individual factors manually using the following type of equipment

Natural Wet-Bulb Temperature Thermometer
Dry-Bulb Temperature Thermometer
Globe Temperature Thermometer
Stand

III. Adjusted Temperature Based Work/Rest Regimens

When wearing impermeable protective clothing, the use of work/rest regimens based on WBGT is not recommended. The WBGT index is designed to account for the effects of evaporative cooling. Vapor barrier clothing impedes the evaporation of sweat and renders the WBGT an inappropriate physiological model. The most important environmental conditions related to heat stress for workers wearing impermeable protective clothing have been suggested to be the ambient dry bulb temperature and the radiant solar heat. These factors are combined into an index called the adjusted temperature using the following formula:

$$T^{\circ} \text{ adjusted} = \text{ambient dry bulb temperature} + (13 \times \% \text{ sunshine})$$

where % sunshine is an estimate of the amount of time the sun is covered by clouds thick enough to produce a shadow. The thermometer bulb should be shielded from radiant heat when taking measurements.

The adjusted temperature values are then used to determine the initial work/rest regimen and physiological monitoring frequency. Table B-3 gives the work period and monitoring frequency. Initially, rest periods will be at least 15 minutes. Physiological monitoring that is normally recommended is pulse rate and body temperature. Procedures for each are described below. Initially, both should be done. Pulse rate monitoring may be discontinued with the approval of the PESM if temperature monitoring proves to be effective.

ATTACHMENT B (Page 5 of 5)**WORK/REST REGIMENS AND MONITORING****A. Pulse Rate Monitoring**

Take the pulse immediately at the start of the rest period (P1). Take the pulse again 2 1/2 to 3 minutes into the rest period (P2). If any of the following conditions exist, shorten the next work period by a third:

$P1 > 110$ beats per minute(bpm)

$P2 > 90$ bpm

$P1 - P2 < 10$ bpm.

Pulse rates can be taken with an electronic pulse meter, or manually with a stopwatch for 30 seconds.

B. Oral Temperature

Take the oral temperature immediately at the start of the rest period. If the oral temperature exceeds 99.5o shorten the next work period by a third. Do not return the worker to hot work in semipermeable or impermeable clothing until the oral temperature is less than 99.5oF.

Oral temperatures may be taken with disposable oral thermometers or infrared ear drum scanners, such as the Thermoscan. Note: If a Thermoscan unit is purchased, the Pro Model should be selected. The home model available through drugstores cannot be recalibrated.

C. Removal from Exposure

If an individual requires a shortening of the work period on more than two consecutive monitoring periods, or repeatedly over a few days, they should be removed from exposure to hot environments wearing semipermeable impermeable protective clothing until examined and cleared for such work by the consulting physician.

Table B-3. Initial Work Period and Physiological Monitoring Frequency¹

ADJUSTED TEMPERATURES	SCHEDULE
90°F or above	15 minutes
87.5° - 90°F	30 minutes
82.5° - 87.5°F	60 minutes
77.5° - 82.5°F	90 minutes
70° - 77.5°F	120 minutes

¹ Schedule is for fit and acclimatized workers in impermeable protective clothing.

FOSTER WHEELER ENVIRONMENTAL CORPORATION

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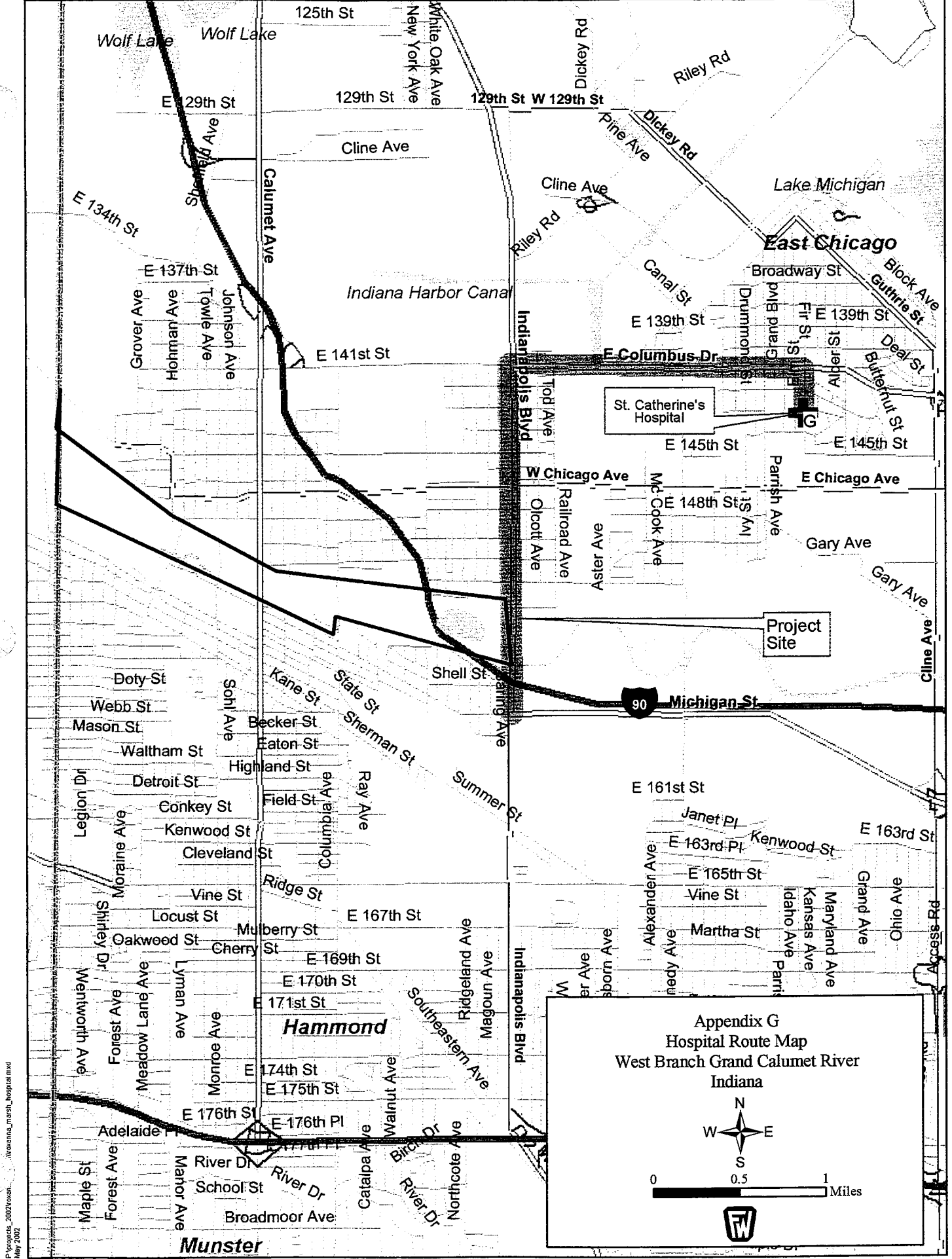
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Proprietary Information

APPENDIX G

HOSPITAL ROUTE MAP



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May 2002

APPENDIX H
FOSTER WHEELER ENVIRONMENTAL
WORK RULES

FOSTER WHEELER ENVIRONMENTAL CORPORATION

GENERAL HEALTH AND SAFETY RULES

1. All site personnel must attend each day's Daily Briefing.
2. Any individual taking prescribed drugs shall inform the FOL/SHSO of the type of medication. The FOL/SHSO will review the matter with the PHSM and the Corporate Medical Consultant (CMC), who will decide if the employee can safely work on-site while taking the medication.
3. All site personnel shall wear the personal protective equipment specified by the FOL/SHSO and in the EHS Plan(s). This includes hard hats and safety glasses that must be worn at all times in active work areas.
4. Facial hair (beards, long sideburns or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.
5. All personnel must sign the site log and the exclusion zone log when used at the site.
6. Personnel must follow proper decontamination procedures
7. Eating, drinking, chewing tobacco or gum, smoking and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone. (Exceptions may be permitted by the PHSM to allow fluid intake during heat stress conditions.)
8. All lighters, matches, cigarettes and other forms of tobacco are prohibited in the Exclusion Zone.
9. All signs and demarcations shall be followed. Such signs and demarcation shall not be removed, except as authorized by the FOL/SHSO.
10. No one shall enter a permit-required confined space without a permit. Confined space entry permits shall be implemented as issued.
11. All personnel must follow Hot Work Permits as issued.
12. All personnel must use the Buddy System in the Exclusion Zone.
13. All personnel must follow the work-rest regimens and other practices required by the heat stress program.

14. All personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.
15. No person shall operate equipment unless trained and authorized.
16. No one may enter an excavation greater than four feet deep unless authorized by the Competent Person. Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.
17. Ladders and scaffolds shall be solidly constructed, in good working condition, and inspected prior to use. No one may use defective ladders or scaffolds.
18. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.
19. The Supervisor must select safety belts, harnesses and lanyards. The user must inspect the equipment prior to use. No defective personal fall-protection equipment shall be used. Personal fall protection that has been shock loaded must be discarded.
20. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.
21. Ground fault interrupters shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out walkways and puddles unless protected and rated for the service.
22. Improper use, mishandling, or tampering with health and safety equipment and samples is prohibited.
23. Horseplay of any kind is prohibited.
24. Possession or use of alcoholic beverages, controlled substances, or firearms on any site is forbidden.
25. All incidents, no matter how minor, must be reported immediately to the Supervisor.
26. All personnel shall be familiar with the Site Emergency Response Plan.

The above Health and Safety Rules are not all inclusive and it is your responsibility to comply with all regulations set forth by OSHA, Foster Wheeler Environmental's Environmental Health and Safety Programs, the EHS Plan(s), the client, Foster Wheeler Environmental Supervisors, and the FOL/SHSO.

APPENDIX I

SITE CONTAMINANTS

Table I-1. Summary of Historical Sediment Chemistry Data for West Branch of Grand Calumet River

Substance	Units	Total No. Samples	Total No. Detects	Overall Average	Overall Standard Deviation	Overall Minimum	Overall Maximum	Location(s) of Overall Maximum(s)
Conventionals								
Acid volatile sulfides ($\mu\text{mol/g}$ units)	$\mu\text{mol/g}$	2	2	354	276	159	550	UG-9
Acid volatile sulfides (mg/kg units)	mg/kg	2	2	11,350	8,863	5,086	17,620	UG-9
Ammonia-nitrogen	mg/kg	56	56	762	513	14	2,140	COL2-39
Percent clay sized particles	%	2	2	0.04	0.01	0.03	0.05	UG9 Top
Percent gravel sized particles	%	5	5	0	0	0	0	
Percent sand and gravel sized particles	%	2	2	83	16	71.4	94.4	UG10 Top
Percent sand sized particles	%	5	5	46	8.3	36.099998	54.3	SD-98-20/2-4'
Percent silt + clay sized particles	%	5	5	54	8.3	45.700001	63.9	SD-98-17/2-5'
Percent silt sized particles	%	2	2	17	16	5.53	28.5	UG9 Top
Metals								
Aluminum	mg/kg	59	59	9,653	4,224	2,800	25,100	087-94
Antimony	mg/kg	78	62	28	43	6	280	SOHL1-09
Arsenic*	mg/kg	123	87	27	35	0.96	210	RO5849
Barium	mg/kg	99	95	178	161	17	782	087-94
Beryllium	mg/kg	59	57	0.8	0.3	0.3	1.8	087-94
Boron	mg/kg	27	19	16	10	3.9000001	37	STATE2-09
Cadmium*	mg/kg	145	110	11	17	0.34	82	MOL2-48
Calcium	mg/kg	59	59	35,250	19,600	8,000	127,000	035-88
Chromium*	mg/kg	133	132	140	226	2.5999999	1,200	RO5847
Cobalt	mg/kg	59	57	10	3.4	3.0999999	18	ROX2-71
Copper*	mg/kg	124	122	194	202	4	1,000	UH9.2/1.1
Cyanide	mg/kg	47	26	2.3	2.9	0.1	12	SD-11
Iron	mg/kg	88	88	47,840	51,890	1,730	260,000	MOL2-70
Lead*	mg/kg	145	139	733	1,417	4.1999998	12,000	MOL2-70
Lithium	mg/kg	56	56	14	6.8	2.7	26	COL2-42
Magnesium	mg/kg	69	69	11,210	4,168	3,100	21,000	ROX2-84 ROX2-90
Manganese	mg/kg	69	69	704	448	190	2,860	050-88
Mercury*	mg/kg	67	53	1.2	1.4	0	5.1	RO5848
Molybdenum	mg/kg	56	50	6.2	7.4	1.3	39	MOL2-48
Nickel*	mg/kg	124	115	57	120	3.5	1,140	035-88
Potassium	mg/kg	78	53	920	465	210	2,100	COL2-42

Table I-1. Summary of Historical Sediment Chemistry Data for West Branch of Grand Calumet River

Substance	Units	Total No. Samples	Total No. Detects	Overall Average	Overall Standard Deviation	Overall Minimum	Overall Maximum	Location(s) of Overall Maximum(s)
Selenium	mg/kg	43	18	12.2	11.1	0.2	26.1	087-94
Silver	mg/kg	99	54	5.1	8.9	0.4	65	SOHL2-33
Sodium	mg/kg	59	57	941	1,729	170	11,000	STATE2-09
Strontium	mg/kg	56	56	50	20	14	130	STATE2-20
Thallium	mg/kg	3	1	5.0	2.4	2.3	6.5	050-88
Tin	mg/kg	75	55	67	86	2.7	359	01RC03SE00
Titanium	mg/kg	56	56	181	47	75	290	MOL2-70
Vanadium	mg/kg	59	58	23	9	8.6000004	49	MOL2-70
Zinc*	mg/kg	124	124	1,627	2,218	17	11,000	MOL2-70
Volatile Organic Compounds								
1,2,4-Trichlorobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
1,2-Dichlorobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
1,3-Dichlorobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
1,4-Dichlorobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Benzene	µg/kg	59	32	9,615	14,920	5.5	50,000	SD-98-20/2-4' SD-98-24/0-2' SD-98-25/0-2'
Semi-Volatile Organic Compounds								
1,2,3,4-Tetrachlorobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
1,2,3,5-Tetrachlorobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
1,2-Dinitrobenzene	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
1,2-Diphenylhydrazine	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
1,3-Dinitrobenzene	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
1,4-Dinitrobenzene	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
2,2'-Oxybis (1-chloropropane)	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2,3,4,6-Tetrachlorophenol	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
2,4,5-Trichlorophenol	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
2,4,6-Trichlorophenol	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2,4-Dichlorophenol	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2,4-Dimethylphenol	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2,4-Dinitrophenol	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
2,4-Dinitrotoluene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850

Table I-1. Summary of Historical Sediment Chemistry Data for West Branch of Grand Calumet River

Substance	Units	Total No. Samples	Total No. Detects	Overall Average	Overall Standard Deviation	Overall Minimum	Overall Maximum	Location(s) of Overall Maximum(s)
2,6-Dinitrotoluene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2-Chloronaphthalene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2-Chlorophenol	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2-Methylnaphthalene	µg/kg	123	75	201,000	460,400	36	3,400,000	STATE2-07
2-Methylphenol	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2-Nitroaniline	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
2-Nitrophenol	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
2-Picoline	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
3,3'-Dichlorobenzidine	µg/kg	4	0	58,250	54,630	26,000	140,000	RO5850
3-Nitroaniline	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
4,6-Dinitro-2-methylphenol	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
4-Bromophenyl phenyl ether	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
4-Chloro-3-methylphenol	µg/kg	4	0	58,250	54,630	26,000	140,000	RO5850
4-Chloroaniline	µg/kg	4	0	58,250	54,630	26,000	140,000	RO5850
4-Chlorophenyl phenyl ether	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
4-Methylphenol	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
4-Nitroaniline	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
4-Nitrophenol	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
Acenaphthene	µg/kg	123	75	133,900	268,400	330	1,400,000	SD-15d
								STATE2-07
Acenaphthylene	µg/kg	123	18	28,380	54,990	170	440,000	STATE2-07
Aniline	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Anthracene	µg/kg	123	81	54,460	92,950	140	540,000	STATE2-07
Benidine	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
Benzo(a)anthracene	µg/kg	132	86	41,420	64,430	-9	420,000	MOL2-68
Benzo(a)pyrene	µg/kg	142	81	40,270	56,440	20	330,000	SD-98-20/2-4'
Benzo(b)fluoranthene	µg/kg	5	5	53,000	27,230	28,000	99,000	RO5849
Benzo(g,h,i)perylene	µg/kg	4	4	46,500	29,190	23,000	89,000	RO5849
Benzo(k)fluoranthene	µg/kg	132	36	26,740	53,910	-9	440,000	STATE2-07
Benzoic acid	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
Benzyl alcohol	µg/kg	4	0	58,250	54,630	26,000	140,000	RO5850
Bis(2-chloroethoxy)methane	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Bis(2-chloroethyl)ether	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Bis(2-ethylhexyl)phthalate	µg/kg	4	3	36,330	32,160	9,300	81,000	RO5848
Butylbenzylphthalate	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850

Table I-1. Summary of Historical Sediment Chemistry Data for West Branch of Grand Calumet River

Substance	Units	Total No. Samples	Total No. Detects	Overall Average	Overall Standard Deviation	Overall Minimum	Overall Maximum	Location(s) of Overall Maximum(s)
Carbazole	µg/kg	4	2	119,000	149,900	11,000	340,000	RO5850
Chrysene	µg/kg	132	91	53,750	97,120	-9	730,000	MOL2-68
Dibenz(a,h)anthracene	µg/kg	107	11	27,830	56,800	330	440,000	STATE2-07
Dibenzofuran	µg/kg	29	21	29,300	61,420	91	330,000	SD-98-20/2-4'
Diethylphthalate	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Dimethylphthalate	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Di-n-butyl phthalate	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Di-n-octylphthalate	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Fluoranthene	µg/kg	139	103	54,330	84,130	10	520,000	STATE2-07
Fluorene	µg/kg	123	79	61,010	102,500	330	590,000	STATE2-07
Hexachlorobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Hexachlorobutadiene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Hexachlorocyclopentadiene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Hexachloroethane	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Indeno(1,2,3-c,d)pyrene	µg/kg	107	25	27,750	56,610	330	440,000	STATE2-07
Isophorone	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Naphthalene	µg/kg	139	85	246,300	560,200	5.5	3,800,000	STATE2-07
Nitrobenzene	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
N-nitrosodimethylamine	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
N-nitrosodi-N-propylamine	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
N-nitrosodiphenylamine	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Pentachlorophenol	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
Phenanthrene	µg/kg	135	114	192,700	345,400	130	1,900,000	STATE2-07
								RO5849
Phenol (µg/kg units)	µg/kg	83	15	20,380	51,690	10	440,000	STATE2-07
Phenol (mg/kg units)	mg/kg	26	0	53	65	0.66	330	SD-98-20/2-4'
Pyrene	µg/kg	136	111	95,840	153,700	110	830,000	STATE2-07
Pyridine	µg/kg	4	0	29,250	27,890	13,000	71,000	RO5850
Tentatively identified compound	µg/kg	4	0	831,400	947,000	214,000	2,242,000	RO5850
Toluene-2,4-diamine	µg/kg	4	0	141,000	133,000	62,000	340,000	RO5850
Total HMW-PAHs (13 PAHs)	µg/kg	142	112	278,400	413,500	20	2,380,000	STATE2-07
Total HMW-PAHs**	µg/kg	128	112	276,600	410,600	20	2,236,000	MOL2-68
Total LMW-PAHs (13 PAHs)	µg/kg	139	117	757,700	1,633,000	1,120	11,850,000	STATE2-07
Total LMW-PAHs**	µg/kg	129	117	874,000	1,766,000	14	11,630,000	STATE2-07
Total PAHs (13 PAHs)	µg/kg	142	120	1,018,000	1,943,000	20	14,230,000	STATE2-07

Table I-1. Summary of Historical Sediment Chemistry Data for West Branch of Grand Calumet River

Substance	Units	Total No. Samples	Total No. Detects	Overall Average	Overall Standard Deviation	Overall Minimum	Overall Maximum	Location(s) of Overall Maximum(s)
Total PAHs**	µg/kg	134	120	1,106,000	2,067,000	20	13,790,000	STATE2-07
Unknown	µg/kg	4	3	612,700	351,700	251,900	1,030,000	RO5850
Polychlorinated Biphenyls								
Aroclor 1016	µg/kg	43	0	3,584	12,040	33	80,000	SD-13
Aroclor 1221	µg/kg	43	0	3,584	12,040	33	80,000	SD-13
Aroclor 1232	µg/kg	43	0	3,584	12,040	33	80,000	SD-13
Aroclor 1242	µg/kg	43	4	3,813	12,060	33	80,000	SD-13
Aroclor 1248	µg/kg	59	18	5,382	11,050	-9	80,000	SD-13
Aroclor 1254	µg/kg	43	2	3,591	12,040	32	80,000	SD-13
Aroclor 1260	µg/kg	43	5	3,627	12,040	33	80,000	SD-13
Total PCBs	µg/kg	62	27	19,910	70,500	-9	560,000	SD-13
Total PCBs***	µg/kg	5	5	4,128	3,936	32	7,937	087-94
Pesticides								
Aldrin	µg/kg	4	0	38	5.3	32	44	RO5849
Chlordane	µg/kg	45	18	1,356	1,932	0.4	8,110	UG10 Bottom
Chlordane - alpha	µg/kg	26	2	172	357	1.7	1,700	01RC03SE00
Chlordane - gamma	µg/kg	26	0	166	358	1.7	1,700	01RC03SE00
Chlordane - reported****	µg/kg	2	2	2,160	28.3	2,140	2,180	UG-9
Dieldrin	µg/kg	45	17	1,971	2,990	0.4	10,900	UG9-C
Dieldrin only (Aldrin not measured)	µg/kg	4	2	1,089	1,512	3.4000001	3,210	UG-9
Endosulfan sulfate	µg/kg	4	0	76	10	64	88	RO5849
Endosulfan-alpha	µg/kg	4	0	38	5	32	44	RO5849
Endosulfan-beta	µg/kg	4	0	76	10	64	88	RO5849
Endrin	µg/kg	26	0	356	711	3.4000001	3,400	01RC03SE00
Endrin ketone	µg/kg	4	0	76	10	64	88	RO5849
Heptachlor (pesticide)	µg/kg	45	16	1,278	2,567	0.4	10,520	UG9 Middle
								UG9-B
Heptachlor + Heptachlor Epoxide***	µg/kg	2	2	955	1,082	190	1,720	UG-9
Heptachlor epoxide	µg/kg	26	0	178	355	1.7	1,700	01RC03SE00
Hexachlorocyclohexane - all isomers***	µg/kg	4	2	856	1,541	1.7	3,160	UG-9
Hexachlorocyclohexane-alpha	µg/kg	4	0	38	5.3	32	44	RO5849
Hexachlorocyclohexane-beta	µg/kg	4	1	55	37	32	110	RO5849

Table I-1. Summary of Historical Sediment Chemistry Data for West Branch of Grand Calumet River

Substance	Units	Total No. Samples	Total No. Detects	Overall Average	Overall Standard Deviation	Overall Minimum	Overall Maximum	Location(s) of Overall Maximum(s)
Hexachlorocyclohexane-delta	µg/kg	4	0	38	5.3	32	44	RO5849
Lindane	µg/kg	45	17	670	1,125	0.4	4,160	UG9 Bottom UG9-C
Methoxychlor	µg/kg	4	0	383	53	320	440	RO5849
o,p'-DDD	µg/kg	3	0	88.5	43.7	62.5	138.9	087-94
o,p'-DDE	µg/kg	3	0	116.3	91.7	62.5	222.2	087-94
o,p'-DDT	µg/kg	3	0	68.7	9.3	62.5	79.4	087-94
p,p'-DDD	µg/kg	35	10	298	629	-9	3,400	01RC03SE00
p,p'-DDE	µg/kg	35	9	2,039	3,564	3.4000001	14,690	UG10 Middle
p,p'-DDT	µg/kg	35	10	663	960	3.4000001	3,400	01RC03SE00
Sum DDD	µg/kg	1	1	60		60	60	UH 8.5
Sum DDD***	µg/kg	2	2	94	119	10	179	087-94
Sum DDE	µg/kg	1	1	4,360		4,360	4,360	UH 8.5
Sum DDE***	µg/kg	2	2	3,680	1,372	2,710	4,650	UG-9
Sum DDT	µg/kg	1	1	1,200		1,200	1,200	UH 8.5
Sum DDT***	µg/kg	2	2	920	1,174	90	1,750	UG-9
Total DDT	µg/kg	45	23	4,467	6,001	1.3	19,970	UG9-B
Total DDT***	µg/kg	3	3	3,130	3,129	178.60001	6,410	UG-9
Total DDT**	µg/kg	33	23	5,345	6,614	1.3	19,970	UG9-B
Toxaphene	µg/kg	43	16	6,138	11,200	0.4	67,000	01RC03SE00
Dioxins								
2,3,7,8-Dibenzo-p-dioxin	µg/kg	10	3	0.0027	0.0018	0.0000073	0.0061	UG9-A

* Heavy metal

** Excluding values with DL>PEC

*** Using the Human Health calculations

**** Using the Human Health exclusion

Notes:

Source data is located in Appendix D

Non-detected analytes were factored into the statistical data and valued at the reported detection limits

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram